ELECTRICAL REVIEW

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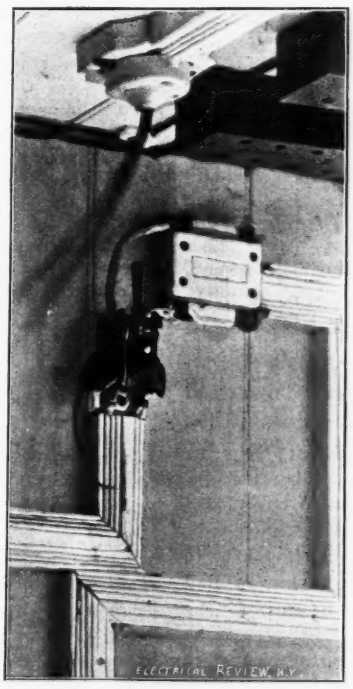
VIEWS, NEWS AND INTERVIEWS

The sinking of the Pennsylvania Railroad Company's ferryboat Chicago a few day's ago off the Starin Pier in the North River, near the foot of Cortlandt street, New York city, may make some extra business for manufacturers of submarine cables. The point at which the Chicago went down, after she was rammed, is about 150 feet off shore, and she lays right on top of from twenty-five to thirty submarine cables belonging to the Western Union Telegraph Company, the Postal Telegraph-Cable Company and the New York Telephone Company. It was feared that when the wreckers began to raise the hulk of the Chicago, which is impeding navigation, their tackle would injure the many cables lying in the bed of the river at that point. With a view to caring for this emergency as quickly as possible, the Western Union Telegraph Company's cable-laying tug, Western Union, hovered about the wreck last week ready to repair cable breaks if any occurred.

In the Flemish language an automobile is a snelpaardelooszoondeerspoorwegpetroolrijtuig.

An American gentleman who is much interested in automobilism, having just returned from England, was telling the other day about his experience in riding through the crowded streets of an English city with a friend who was operating a British electromobile. "I was tremendously nervous," he said, "because whenever we encountered an approaching vehicle my friend turned out to the *left*. That's the rule of the road there, but it upset me completely. To turn out to the right is instinctive with an American, and it would take months of trying to forget and learn that right is wrong and left is right before I would dare to steer an automobile in a British town."

A company has just been formed in Athens, Greece, to be known as the Greek Electrical Company, with a capital of $1,000,000. The founders of the company are the Athens Bank and the Société Generale d'Enterprises. The object of the new company is not only to undertake electric lighting in Athens, the Piraeas, Syra, Patras and Kalama, but also to construct an electric railroad in Patras. The capital of the company is to be increased, if necessary, and the extensive works to be undertaken will require considerable material, which will have to be imported. The competition for the machinery and equipment and material will be principally between English, German and American firms.



FIGS. 1 AND 2.—CURIOUS ELECTRICAL ACCIDENTS.

The British military authorities expect to have the wireless telegraph in operation in South Africa within a few weeks, when it is hoped the difficulties experienced from the cutting of wires will be overcome.

A physician at Racine, Wis., claims to have about completed a machine called the phono-typewriter, which will work the keys of a typewriting machine when the operator talks into an ordinary phonograph, with which it is connected. Just how this operation is performed has not been divulged.

"In the early days of the telephone," said an ex-Wall street man, "the firm of brokers I was connected with refused to allow an instrument in their office. They said it was a fad which would never work, and that Wall Street couldn't bother with 'toys.' Imagine the transaction of business in Wall street to-day without the aid of the telephone!"

A New York city Alderman offered to the Board last week a resolution, which was referred to the Committee on Streets and Highways, permitting one of his constituents "to wear an electric shirt on the streets, avenues and thoroughfares of the borough of Manhattan, under the direction of the Chief of Police."

The syndicate which owns the street railways in Havana, Cuba, is still placing orders for electrical apparatus in New York. These include contracts for trucks, cars, generators, motor equipments and miscellaneous supplies. Mr. George F. Greenwood is general manager of the company.

Professor Andrew Gray, M. A., professor of electrical engineering and physics at the University College of North Wales, Bangor, has been appointed to succeed Lord Kelvin in the Chair of Natural Philosophy at the University, Glasgow.

Curious Electrical Accidents.

In the annual report of the Wire Department of the city of Boston for the year 1898, recently issued by Mr. Thomas W. Flood, Commissioner of Wires for that city, there are described, among other curious accidents and fires caused by electricity, two of great singularity, which are illustrated herewith, the photographs having been made by Mr. J. Paul Haynes, of the Boston Wire Department. Fig. 1 shows a hole burned entirely through a wooden partition by an incandescent lamp. It appears that this lamp hung against the partition, and was left lighted all one night, with the curious result so clearly shown in the illustration. Fig. 2 shows the unintentional electrocution of a rat. This creature seems to have avoided the most carefully constructed traps, and was evidently making his way along the moldings shown in the illustration and attempting to pass through behind the jaws of an ordinary double-pole jack-knife switch in the 110-volt incandescent light circuit. The picture shows the result.

One fire was caused by sending 2,000 volts current into a recording wattmeter designed for 1,000 volts, the shunt coils of which promptly burned out. Another was due to flying particles of an exposed fuse wire which blew in a closet containing clothing and set fire to the fabrics. A curious fire was one which consumed the base of a telephone pole. This pole carried a fire-alarm box. The fire-alarm circuit was crossed by an arc-lighting circuit, and that, in turn, crossed by the primary wires of an alternating circuit, current from which charged the fire-alarm circuit and the box, escaping to the earth by means of the ground wire, at which point the pole was ignited.

An extraordinary disturbance took place on the Berkeley street bridge, due to the fact that the fall (a steel wire) of one of the derricks used in the construction of the retaining wall on the south side of the tracks of the Boston & Albany Railroad came in contact with the overhead trolley wire of the Boston Elevated Railway Company. From this point current from

the trolley wire was conveyed over a steel guy wire that was fastened to the iron frame-work of the bridge, thence to a 16-inch gas main, which rested on the bridge, melting out a portion of the metal about five inches in diameter, also badly melting the metal plate on which it rested. Flame and smoke were visible from different portions of the bridge, particularly at the points where the steel guy rope was attached and where the gas main rested on the metal plate. The injury to the gas main was such as to necessitate the removal of the damaged length.

NOTE ON LIGHT.

BY WILLIAM ROLLINS.

NOTE LXXI—GROUNDING THE ANODE OR THE TARGET.

Many operators ground the anode, as it is supposed by them to prevent burning the patients.

The following experiment proves that it diminishes the light, and, as Tesla's screen prevents burning, the anode should not be grounded. Take the tube shown in Fig. 2, or the one shown in Fig. 59, and connect the target, which is at the same time an anode, with the ground by a fine wire, which can be removed without jar while the observer is looking in the fluoroscope. We shall find that the moment the connection with the ground is severed the light increases. If we make one of the concave aluminum terminals an anode and the platinum plate a target only, grounding it in the same way, we shall, on repeating the experiment, get the same result.

Some Pointers on Export Trade.

In *Peck's Buyers' Index*, of New York, for October, 1899, is an article, entitled "Crooked Things Set Straight," which contains several good pointers for electrical manufacturers engaged in export trade. It is there advised that manufacturers publish their catalogues in sections, so that, when a foreign buyer makes a request for information regarding a specific thing, he may secure the information without additional matter, for which he does not care. Catalogues in paper covers are more economical than those in cloth board bindings, on account of the charges by express companies for carrying them. It is also strongly urged that the publishing of list prices, subject to endless discounts, be discontinued, and the more direct method of quoting net prices be adopted.

NEW TELEPHONE ORGANIZATION.

THE PLANS AND PROSPECTS OF THE CONTINENTAL COMPANY.

PROMINENT CAPITALISTS ENGAGED IN CONSOLIDATING THE INDEPENDENT TELEPHONE COMPANIES AND EXTENDING THE SERVICE — HEADQUARTERS IN NEW YORK, AND CAPITAL $25,000,000—THE TELEPHONE SITUATION REVIEWED—PATENTS OF IMPORTANCE.

The first company to operate the telephone invented in 1876 by Alexander Graham Bell, was entitled the National.

The first powerful and comprehensive opposition to the interests accumulated under Bell's patents is to be entitled the Continental.

The present title of the successor of the Bell National Company is the American Bell Telephone Company, with the American Telephone and Telegraph Company as its "long-distance" ally, and the Western Electric Company as its manufacturing and supply house. The licensees of the parent Bell company comprise some fifty local organizations, covering specified territory, all paying tribute in capital stock and royalties to the Bell company. It is also an understood law that telephones and telephone supplies required by the local companies shall be purchased from the manufacturing house named, and this has been a leading factor in the building up of the Western Electric Company until, with immense factories in New York and Chicago and several European capitals, it has maintained the position from its birth of the largest electrical manufacturing house in its line, or probably in any line in the world.

The total capital thus invested and authorized under the patents of Bell amount, in close estimate, to the following:

American Bell Telephone Company, Boston	$50,000,000
American Telephone and Telegraph Company, New York	75,000,000
Licensees, Bell company.	100,000,000
Western Electric Company, Chicago	20,000,000
Total	$245,000,000

So much for the Bell interests, which, all must admit, have been ably managed and are now thoroughly equipped.

The expiration in 1894 and since of all but one of the basic patents of Bell and others, owned in this interest, opened the field to new companies, and under the influence of energetic and far-seeing manufacturers telephone exchanges sprung up all over the United States. To-day there are nearly 3,000 exchanges, known as "Independents," operating under different managements and with telephone apparatus supplied by "Independent" manufacturers, some two dozen and more of which are now turning out an excellent product. The object, apparently, of the new telephone company is to get all these operating companies under one management, connecting all of them, as far as practicable, in one long-distance system and provide telephone service at a decided reduction from Bell rates.

THE CONTINENTAL TELEPHONE COMPANY.

There was published in the ELECTRICAL REVIEW last week the announcement of the organization of the "Continental Telephone, Telegraph and Cable Company," with the names of such well known capitalists as John Jacob Astor, George Gould, William C. Whitney, P. A. B. Widener and William L. Elkins as interested parties. The daily press of New York, the *Herald* most thoroughly, immediately exploited the new company, and much excitement and some misinformation quickly followed. It was evident, however, that at last an organization had been proposed with brains and capital ready to compete with the giant Bell company in the constantly broadening field of telephone work. The name of Mr. Gould carries with it the conclusion that the Western Union Telegraph Company, of which he is the largest owner, would be allied with, or at least not opposed to, the new company. Perhaps the inroads the long-distance service of the Bell Telephone Company has made in the use of the telegraph has not a little to do with this decision. The Western Union has owned for years a minority interest—40 per cent—in the New York Telephone Company, the most important of the Bell licensee companies. No announcement of the sale of this holding has been made and Mr. Gould is still a director in the New York Telephone Company.

A representative of the ELECTRICAL REVIEW called to see Mr. Gould on Monday of this week, and in his absence was told by his private secretary that "Mr. Gould was not interested in the new telephone company." The telephone public will await with interest further developments as regards the attitude of the Western Union Telegraph Company towards the Bell company.

Several companies have been formed to furnish telephone service in this city, in opposition to the New York Telephone Company. The applications of the Knickerbocker and the People's telephone companies for permits to use the subways of this city for laying wires and cables have been approved by Col. H. S. Kearney, the public official in charge of this department. The question of subway facilities is a very important one, and just how completely the present subways have been utilized by the established company, future developments will show. There is, besides, a vast subway system owned by the Metropolitan Street Railway, which is controlled by Mr. Whitney, who is understood to be allied with the new telephone company.

As stated in the ELECTRICAL REVIEW last week, Mr. Martin Maloney, an enterprising capitalist of Philadelphia, has been the prime mover in the work of organizing the Continental company and securing the strong support of the gentlemen named above. When seen by a representative of the ELECTRICAL REVIEW at his office, 100 Broadway, New York, Mr. Maloney said:

"We haven't taken in any 3,000 companies. That would mean practically every company in the country. But we have secured control of about twenty-five per cent of the whole independent telephone interest, and shall control all the territory east of Chicago. Our paid-in capital is fixed at $25,000,000, and that is more than twice over-subscribed. Our charter is already drawn up, and within ten days we shall be incorporated under the New Jersey law. We have made all our plans, down to the smallest point, and the conditions are entirely satisfactory to us."

Mr. P. A. B. Widener, in an interview, when questioned as to the intentions of the new company, said:

"We found there was an astonishing number of small and independent companies doing business in various parts of the country. These small concerns were practically useless outside of their own immediate sections. The plan, therefore, at once presented itself of combining all these companies and of making one great system that would give a long-distance service, outside of the Bell lines, in any part of the country. To do this it would take an immense amount of capital and a man at the head who could

bring all these various concerns into harmonious control, under one grand corporate head. Mr. Maloney has been at that task, and we have now companies in nearly every state in the Union, incorporated in a system that gives a complete connected service throughout the New England, the Middle and Southern States and the West. In Pennsylvania alone we have secured rights that will prove of immense value. Throughout the state of New York it is the same way."

Mr. Widener stated that Mr. J. Pierpont Morgan was not interested in the new company, as had been reported. It is generally supposed that Mr. Morgan is a large owner of stock in the American Bell Telephone Company.

The name of the permanent company will be the Telephone, Telegraph & Cable Company of America, of which Mr. W. J. Latta will be president. Mr. George W. Beers, formerly of Fort Wayne, an active worker in the independent telephone field, is connected with the new organization.

Among others who will be connected with the organization in addition to those already named are Mr. C. R. Flint, of New York, and Mr. Thomas Dolan, of Philadelphia.

It is understood that the new company will not enter the manufacturing field, but purposes to control operating companies exclusively, and for that purpose will engage the ablest men identified with the independent movement.

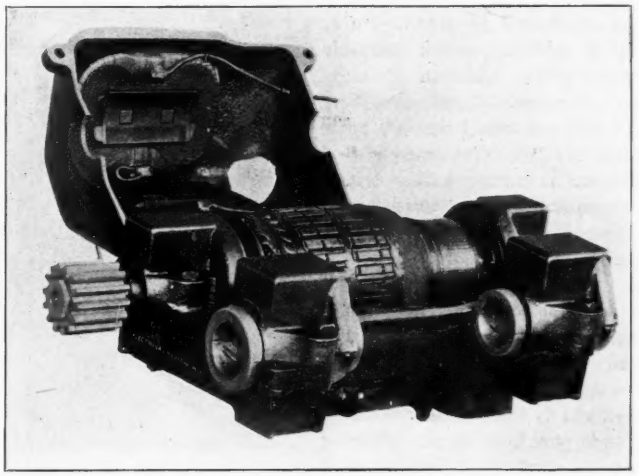
THE BERLINER TRANSMITTER PATENT.

The basic patents on which the Bell company founded its great business, as before stated, have all expired, with the exception of the important Berliner transmitter patent. This patent, after a long delay in the Patent Office, was issued November 17, 1891, and consequently has nine years of life remaining. It is No. 463,569, and is for a combined telegraph and telephone, and is claimed by its owners to cover all forms of microphone transmitters or contact telephones. Suits for infringement against two Boston manufacturing companies—the National and the Century—have been brought by the Western Electric Company, representing the Bell company, and the decision of the court is awaited with much interest. It is expected this month.

INDEPENDENT MANUFACTURERS.

The wonderful spread of the manufacturing interests in the telephone industry, since the field became open to all, is shown by the long list of companies engaged in turning out instruments of a high order. Inventive and mechanical genius in this field received a new impetus, and the work of the independent manufacturing companies has been a constant tribute to the energy and resourcefulness of the American manufacturer and inventor.

A new telephone and transmitter with unusual powers for transmitting clearly over long distances has been quietly perfected, a factory equipped in this city and plans made for turning the instruments out on a large scale. The work has gone ahead so quietly that outside of the factory force scarcely a half-dozen know of the instrument's existence. It is believed by the ELECTRICAL REVIEW that this important instrument will enter largely into the long-distance telephony of the new company.



A NEW TYPE OF STREET RAILWAY MOTOR.

A Letter on the Proposed Telephone Consolidation.

The ELECTRICAL REVIEW has received from Mr. J. E. Keelyn, of Chicago, a prominent manufacturer of telephones and telephone apparatus, a communication discussing, at some length, the independent telephone situation and the proposed consolidation of the independent companies. Mr. Keelyn does not believe that the scheme for controlling the entire telephone and telegraph business of the country will be carried out successfully, and concludes, as follows:

"The business does not seem much different from what it did to me seven or eight years ago when I started as a pioneer, except that the changes anticipated then have become a fact. I contemplate now, with just as much assurance, the future condition of this business ten years hence as being more and more divided up with respect to local systems than at the present moment; with government, state and municipal influences to protect the people against such a monopoly as the wild stories of these big syndicates suggest.

"The writer has always been convinced that a combination of the telephone and telegraph business for long-distance purposes was a conclusive eventuality. Further, the magnitude of this long-distance business is so great, if carried to its successful development, that only the government could hope to satisfy the public needs. It is more important to-day that the government should control the telephone and telegraph systems of the United States than that they should operate the postal system, and it will grow more important in future as the people utilize the telephone and telegraph more and the mails less, proportionately.

"I am not to be understood as recommending government ownership of anything which can be better maintained by private or corporate control, but I do believe that the government will, sooner or later, need to control the inter-communication business between cities of the United States.

"I do believe further that the operation of telephone systems within municipalities is a more favorable enterprise for municipal control than that of an electric light plant or a gas plant. In fact, next to the waterworks and fire department and police department, telephone systems should rank as necessary to municipal control.

"The Bell monopoly, reputed as the finest commercial organization in existence, with absolute control of the business throughout the United States and unlimited capital to aid it, was unable to withstand independent development of the telephone industry.

"Four years ago I discussed the subject with the vice-president of one of the biggest telegraph companies in America—a gentleman quite as well posted on the telephone business as any one connected with the Bell company. He said: 'Keelyn, within two years there will not be an "independent" telephone company left.' Further: 'The telephone and telegraph are two separate and distinct industries, and are not susceptible to successful amalgamation.'

"I answered him, saying that at the end of the two years mentioned he would suddenly be made to realize that the 'Independent' telephone interest would be quite as great as that of the Bell telephone interests, and that the telegraph companies would about that same time begin to regret lost opportunities. I am willing now to be recorded again upon the propositions set forth herein."

JAMES E. KEELYN.

Chicago, November 6.

A New Type of Street Railway Motor.

The illustration shown herewith represents a new type of enclosed single-reduction-gear street railway type motor, having a maximum of about 60 horse-power. The illustration shows the motor with the lower part of its case swung back on its hinges to expose the armature, and represents the motor upside down—that is, the part that is now shown, as the bottom goes against the floor of the car when the machine is mounted. It will be seen from the illustration that the principal features of the motor are a very deep slot winding of the armature, large lubricating provisions at the various journals, and very compact design. The motor has four salient poles. This is one of 300 motors recently ordered by street railway systems in Chicago, Kansas City and San Francisco from the Siemens & Halske Electric Company of America, Chicago. It is understood that this company has entered the street railway motor field as an active competitor.

The Sweets of Acetylene.

We are constantly told of the virtues of acetylene as an illuminant; but, while there is no denying that the light which it gives is exceedingly powerful, there are sundry undoubted drawbacks, which must seriously hinder any widespread use of it. One is its most evil odor, of which the poet sweetly sings (I quote from memory):

There was an old man of Clonmell,
Who detected a horrible smell;
But whether 'twas drains or acetylene mains,
He was wholly unable to tell.

The other is its tendency to explode upon little or no provocation, of which a sad instance is reported from Tutbury, near Burton on-Trent, where a man has been injured fatally by the explosion of a portion of some generating apparatus which he had taken home to overhaul. On the whole, the public will be well advised to keep acetylene gas at a respectful distance—at all events, until it has been amended in these trifling particulars.—*From (London) Electricity.*

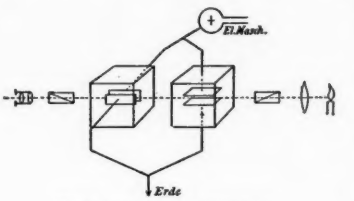
SCIENCE BREVITIES.

Thorium Radiation—Professor R. B. Owens describes, in the *Philosophical Magazine*, the apparatus he used for a variety of experiments on the radiation from thorium salts. The most important element in the investigation is the constancy of the radiation, since that is at present absolutely unaccounted for. The salt was spread on a horizontal platinum plate, above which, at a short distance, a copper plate was mounted. A current was sent from the platinum plate through the ionized air to the copper plate, and thence through an electrometer to earth. When the oxide was used a considerable increase in the leakage current was observed in the first few minutes, but then the current became constant. The time effect is much smaller in the case of the nitrate and sulphate, but about equal in these two salts. A current of air driven across the space between the two plates has the effect of lowering the current traversing it. It is immaterial whether the air is dry and free from dust or not. The thicker the radiating layer the more sensitive it is to the effect of air currents. A sheet of paper or aluminum foil laid over it diminishes the disturbing effect of air currents. All these circumstances indicate that the cause of the radio-activity lies close to the surface of the active material.

Measurement of Inductance—Mr. G. W. Patterson, writing in *Wiedemann's Annalen*, an article which is abstracted by Mr. E. E. Fournier d'Albe, compares the efficiency of two different methods of measuring self-induction, that of Maxwell as improved by Rayleigh, and that of Oberbeck, in which the coil of unknown self-induction and known resistance forms one branch of a Wheatstone bridge, the coil of an electro-dynamometer takes the place of the galvanometer, and a zinc inductor that of the battery. The Maxwell-Rayleigh method requires accurate resistances, a good ballistic galvanometer and a constant temperature. Oberbeck's method is not so critical as regards resistances or constancy of temperature, but requires a sensitive electro-dynamometer of rather high resistance and low inductance, and a constant source of sinusoidal electromotive force. Oberbeck's method has the advantage of being in a certain sense a null method, for two points of equilibrium must be obtained, one with a continuous and the other with an alternating current, corresponding to the two enduring and two ballistic deflections in the other method. On the other hand, a galvanometer is far superior to an electro-dynamometer in sensitiveness, when the latter contains no iron, and iron is excluded by the fact that its presence would make the self-induction a function of the current. In the case of very small self-inductions, the Joulean heat developed interferes with the usefulness of Maxwell and Rayleigh's method.

Magnalium—This is the name of a new alloy of aluminum and magnesium, discovered by Dr. L. Mach, which is said to possess valuable properties. The addition of magnesium, in quantity not exceeding thirty, and not less than ten, parts by weight to 100 parts by weight of aluminum, imparts to the latter metal properties which, in the pure condition, it does not possess, without raising its specific gravity (2.64), on the contrary, slightly lowering it, since the specific gravity of magnesium (1.74) is even less than that of aluminum. The addition of magnesium produces an alloy which is harder, and is easier and cleaner to work than pure aluminum. Turning produces a surface as bright as a mirror and shining like silver, the metal coming off in long spiral turnings. The alloy files clean and regular, without tearing or choking the file, as aluminum does. Deep and sharp screw threads can be cut on it, and very clean holes can be bored out. The color of the metal resembles silver, more than aluminum, and it takes a high polish. The hardness and strength of the alloy are considerable; the hardness can be varied by varying the proportions of aluminum. An addition of heavy metals is not only unnecessary, but is positively injurious, since this deteriorates its working properties and increases its specific gravity. Previous attempts to make useful alloys of aluminum and magnesium are said to have failed, owing to the aluminum not being pure. This point is of great importance, and aluminum made by an electrolytic process must be used.

Capacity Measurements by Means of Electrical Double Refraction—A very interesting experimental arrangement was described by Herren R. Wachsmuth and K. Bergwitz in the *Physikalische Zeitschrift*. If an alternating-current circuit is branched and a capacity connected in one branch and a non-inductive resistance in the other, there will result a phase difference which can be used as a measure of the capacity. The electrical double refraction of carbon bisulphide has been used by the authors to measure this phase difference. Referring to the figure, if a ray of a plane of polarized light is sent between two plane parallel plates immersed in carbon bisulphide, and these plates are submitted to a difference of potential, the included fluid will behave, as is well known, as a uniaxial crystal would under the same circumstances, rotating the plane of polarization. If, now, a second pair of plates, similar to that described above, and equally charged, but having planes at an angle of ninety degrees to those of the first pair, is also included in the path of the beam, its influence will counteract that of the first pair. This arrangement of the two pairs of plates is included between crossed



CAPACITY MEASUREMENTS.

Nicol prisms in the path of a beam of plane polarized light, as shown in the illustration. If a capacity be put into either branch, so that the capacities of the two are no longer equal, the distributing effect produces illumination in the eye-piece at the left, and it is necessary to insert resistance in the other branch to compensate for the capacity and again produce darkness. The calculation of the capacity from the resistance necessary is a simple matter.

Canal Haulage—Some very interesting experiments in the electrical hauling of canal boats are being made at Tinow, under the auspices of the German Government. The first system being experimented with is due to Messrs. Siemens and Halske, and is in general design not unlike the Thwaites-Cowley system. Instead, however, of having an elevated rail for the hauling carriage to run on, in this system an electric cable is used. This cable is used as the earth conductor, and the trolley wire placed over it serves as the other. The disadvantage of the system will be the uneven hauling motion due to the sagging of the cable. Thus, at every point of support the motor carriage will meet with an up-grade which will check its speed, and, immediately the support has been passed, the motor will receive considerable impetus while running down the sloping cable. But for this drawback the system can be very cheaply arranged, and it does not involve so much structural work on the limited space usually available on the towpath. The other system employs a small locomotive to do the hauling, and is remarkable from the fact that only one rail has to be laid down for this locomotive. The other wheels are made broad to run on the towpath.

Air Resistance—There is still a vast amount of original work to be done in determining the air resistance offered to moving bodies at different speeds. The most recent researches on this subject were undertaken in view of a prize offered by the Société des Encouragements for the best experimental study of the resistance of air to moving bodies. Two prize papers on the subject were recently published in the *Bulletin* of the society. The first of these was sent in by Mr. Le Dantec, and the second one by Mr. Canovetti. The first-named experimenter used a surface of a square metre sliding down a vertically-stretched wire. He arranged some most complete apparatus for recording the speed of the falling plate at any moment and time, so that all personal errors of observation were eliminated. The conclusions of the author of the paper were briefly, as follows: He found that a square plate, one metre in each direction, when moving at a velocity of one metre per second, had to overcome an atmospheric resistance of eighty-one grammes. Mr. Le Dantec then tried other surfaces with the same area, but with a different outline. His conclusions are that the resistance of the air is then proportional to the length of the perimeters. The third conclusion he arrived at was that the rule that the resistance of the atmosphere varies as the square of the velocity is correct. The other successful competitor, Mr. Canovetti, did not devise such good recording apparatus, and trusted to personal observations. In this case the surface was allowed to run down an inclined wire with a gradient of twenty-five degrees. Of course, with this arrangement, the wire was not an absolutely true surface, and this introduced certain errors. He made the resistance of the metre-square surface to be ninety grammes at a velocity of one metre per second, so that there is considerable discrepancy between the two results. This author also carried out tests on spheres, cones, etc.

The Storage Battery in Telephone Exchanges.

Modern telephone practice has made a great advance by centralizing the batteries needed by the subscribers in talking. This practice not only results in direct saving of cost of battery power, but also materially improves the efficiency of the service by having the batteries together and in a place where they are under constant supervision of experienced men. The storage battery also furnishes all current for automatic signaling. A typical telephone installation of this kind, similar to that in Brooklyn, described in the ELECTRICAL REVIEW of November 1, is that put in operation in the exchange of the Bell Telephone Company, of Philadelphia, situated at the corner of Eleventh and Filbert streets, in 1898.

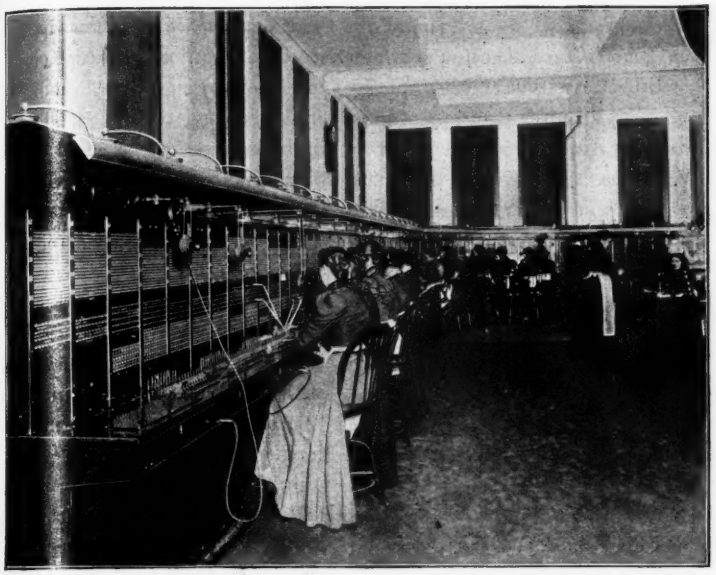


FIG. 1 FRONT VIEW OF SWITCHBOARD IN THE BELL TELEPHONE EXCHANGE, PHILADELPHIA.

Situated in the engine room are two machines, forming a duplicate plant, each consisting of one engine, direct-coupled to a 30-kilowatt, 110-volt dynamo. These machines are run alternately every other day, and are used for lighting the building and furnishing power at 110 volts to motor generators in the power room on the sixth floor, used for charging the storage batteries and furnishing ringing power to the telephone switchboard. The motor generators have their primary ends connected to the 110-volt direct-current circuit fed from the generators in the basement.

These motor generators comprise two 1,500-watt machines for charging a 20-volt battery, one 1,500-watt machine charging an 8-volt battery, one 500-watt machine charging a 4-volt battery, and two ¼-horse-power, 75-volt, alternating-current motor generators for ringing. Only one machine is furnished for the 8-volt and the 4-volt batteries, which are in duplicate. To avoid a possible breakdown, an enamel rheostat is furnished, so that the batteries of lower voltage can be charged from batteries or motor generators of higher voltage. All machines are protected with automatic safety cutouts.

The 20-volt battery consists of ten accumulators having a capacity of about 1,000 ampere-hours, which furnish all the current needed by the subscribers for talking and for calling up the office. The 8-volt batteries, in duplicate, each consists of four cells having a capacity of 2,400 ampere-hours. This battery furnishes current for the "disconnect" signals on the operator's cords, and for the relays which cut out the subscriber's lamp signal when the operator answers his call by plugging into the jack corresponding to the lamp signal. The "disconnect" lamps are so wired that they burn only when the subscribers connected by the cord need attention from the operator. They do not light while the subscribers are talking.

Half the drop in potential of the 8-volt battery is in the 4-volt lamp, and the other half in the cutout relay. This battery is in duplicate, so that one can be charged while the other is being discharged. This avoids danger of burning out the lamps, as the voltage of the battery is raised from eight to ten volts during charging. The 4-volt battery consists of six cells in duplicate. One of these sets consists of four cells, two in series, two in multiple; the other of two cells. The two extra cells are needed on one of the batteries to supply current for the operator's transmitters. This battery is arranged to furnish a current of four volts or two volts as desired. The 4-volt battery also furnishes all current for lighting the lamp signals which light when a subscriber takes his telephone off the hook. This lamp is put out when the operator answers the call, as was described under the 8-volt battery. This battery is made in duplicate, one being charged while the other is discharged, to avoid burning out the lamp from the higher voltage during charge.

The power switchboard and mounting fuseboard are constructed of white marble, mounted on an iron frame, and equipped with switches, measuring instruments, fuses, etc., for the necessary circuits.

The function of the battery is as follows: The subscriber, by taking his telephone off the hook, operates a relay at the central office, which operates a 4-volt lamp in front of the operator at the switchboard; this lamp is extinguished as soon as the operator plugs into the jack. The cord with which the operator connects together the jack of the subscriber calling with that of the subscriber desired is wired to the 20-volt battery, which furnishes all the current used by the subscriber in talking. The automatic 4-volt lamp "disconnect" signals on the operator's cords are operated in the manner already described.

This storage battery installation was furnished by the Electric Storage Battery Company, of Philadelphia.

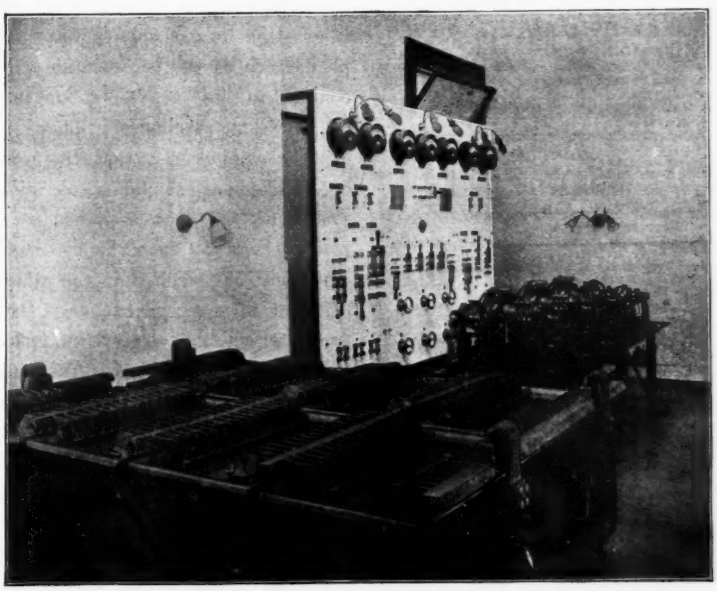


FIG. 2.—GENERATING AND STORAGE BATTERY PLANT, BELL TELEPHONE EXCHANGE, PHILADELPHIA.

BOOK REVIEWS.

"Electro-Horticulture." By George S. Hull, M. D., Sc. D. The Knickerbocker Press, New York.

This little volume is a collection of fantastic speculations of an interesting but entirely impracticable character.

"Magnetism and Electricity." By J. Paley Yorke. Edward Arnold, London. Price, $1.25.

This admirable elementary treatise, while short and concise in its treatment of the subject, is nevertheless scientific in arrangement, sensible and clear in style, and is a book admirably adapted to the classroom or to the needs of the layman who wishes to inform himself upon electrical subjects. It begins the treatment of electricity with the subject of magnetism, works up through current electricity, and saves for the last the complex and difficult phenomena of electrostatics.

"La Télégraphie sans Fils" (Wireless Telegraphy). By André Broca. Gauthier Villars, Paris.

This little book is an exceedingly clear explanation of the phenomena upon which wireless telegraphy is based, and an admirable *résumé* of the theories of the subject, but is, unfortunately, written for the student in electricity rather than for the practitioner. The first chapters, which deal with mechanical analogies to electric currents, are somewhat reminiscent of Professor Lodge's lectures, but, notwithstanding, are highly interesting. The latter chapters in the book deal with the mathematics of electrical waves and are difficult of comprehension except to the initiated.

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CHARLES W. PRICE, - - - - - - - EDITOR.
STEPHEN L. COLES, - - MANAGING EDITOR.
CHARLES T. CHILD, - - TECHNICAL EDITOR.
STEPHEN H. GODDARD, ADVERTISING MANAGER.

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RUSSELL HOWLAND, GENERAL REPRESENTATIVE,
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FRANK E. COLBERT, REPRESENTATIVE,
935 Old Colony Building, Chicago.

WASHINGTON OFFICE:
GEO. C. MAYNARD, - REPRESENTATIVE,
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HENRY W. HALL, - - REPRESENTATIVE,
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THE TELEPHONE SITUATION.

It seems that at last the independent telephone interests of the United States are about to be combined in a strong organization, which will be more nearly a real competitor of the American Bell Telephone Company and its allied concerns than the 3,000 or more scattered and separate independent companies now are.

The possibilities of the telephone business in the United States under the new conditions which are foreshadowed invite much interesting speculation. More than most other public service utilities, the telephone is a natural monopoly; it depends for its usefulness upon the ability of any subscriber to speak with any other within a reasonable distance of him. This, of course, means that the management of telephones can not well be distributed among a number of concerns which are mutually inimical, but must be gathered together in such a way that messages may be freely exchanged between any station and any other. In any city where there is a telephone exchange a vast preponderance of the conversations are confined to those between subscribers of the same exchange. There is often need, however, that the user of a telephone should speak with some one in another town. In places where the recent independent movement has resulted in the establishment of a second exchange, between which and the original telephone installation there is no communication, the general result has been that busy people have required two telephones. This has been, at the least, an inconvenience, and, in general, a nuisance.

The weakness of the independent telephone movement has been in the absence of a system of long-distance lines connecting towns and cities in which there are exchanges of this character. If the new movement is successful in combining the numerous competitive exchanges under a single centralized management, and if long-distance lines are erected, the result can not fail to be beneficial to business generally and profitable to the promoters. For the first time the Bell company will have a genuine long distance or extra-territorial competitor, and it is not likely that the competitive conditions will fail to produce decided results. At the same time it is equally unlikely that competition will last forever. It is the tendency, strongly marked in all directions, for the elements of industries of whatever kind to amalgamate for the general betterment of business conditions. Without going into any argument upon the propriety of these coalitions, it will be recognized by every one that, to-day, the whole movement in industrial lines is toward such combinations.

It is perfectly evident that the time is fully ripe for a strong combination of the independent interests. Indeed it seems curious that this has not been made before. If it is made, the time again will be ripe for a combination between the independent and the Bell interests, and the situation may become in no way different from what it was before the independent movement started. Meanwhile we have before us the example of the United States Post Office engaged in transmitting intelligence between the people, and the British postal telegraph system engaged in the same work to the satisfaction of its constituency.

AMERICAN EXPORTS.

The most extraordinary phase of the present-day commercial situation is the rapid growth of American export business. In no line is this more marked than in that of electrical manufactures. A discussion of the reasons leading to this satisfactory state of things is hardly necessary, and is certainly not so interesting as the consideration of the facts as they are. We are, to-day, supplying electrical machinery and under-bidding, both in point of contract price and time of delivery, British, French and other makers in their own territory. While these markets are, for the present, exceedingly attractive, we should not lose sight of the fact that the opening of a new territory to civilization brings with it the opening of new trade possibilities.

The course of empire has always been westward, and it now appears that empire has taken the long leap across the Pacific, and that the dominant nations will push on into the Asiatic countries in which they originated in the dawn of history. It is hard to say what is the biggest factor in the promotion of civilization, but it is certain that swift means of communication are numbered among the first. The dependence of these in many cases on electrical methods is becoming more and more established. The trolley car and the electric light are agencies certainly as good as the dum-dum bullet and the dynamite shell for the great work of progress. These are good things to remember and think about.

To speak very plainly, we may have only a certain altruistic interest in the advance of civilization, while we all have a direct interest in the expansion of markets for our manufactures. If these things can go along together everybody will be well satisfied, and, at the moment, it looks as if we were destined to accomplish much in civilizing backward communities and spreading proper influences—more with our dynamos and motors and lamps than with our cannon.

The paper on the nature of physical laws by Professor J. H. Poynting, which appears in another column, contains much to interest the thoughtful student of electrical physics. Perhaps the most valuable point in it is that physical laws are not laws at all. They are simply the statements of experience, and no phenomenon ever disobeys a law; apparent disobedience means simply that the law is wrong as we have defined it. Most electricians of middle age will remember that in their youth Ohm's law was an absolute dogma. To-day it is known to be true only in special cases. If we can free ourselves of the domination of thought which is involved in a too close adherence to the letter of what is called physical law, we may suddenly achieve great results. Every man who thinks seriously upon the great problems of the nature of things, of matter, of ether, of force, is apt to be circumscribed by the bonds and limits which the language of physical statement has put upon his imagination.

Colonial Cables.

General A. W. Greely, chief signal officer of the United States Army, has issued his annual report. In it he says that the Signal Corps has in operation in Cuba no less than 2,500 miles of telegraph, of which 600 miles are absolutely new lines. For the five months ending June 30, 1899, the telegraph receipts in Cuba aggregated $131,261. For the six months ending on the same date $64,314 was spent in the reorganization and operation of the Cuban lines.

In Porto Rico the telegraph system was destroyed by the hurricane which brought to the ground every mile of telegraph or telephone wire on the island, over 1,200 miles in length. General Greely renews his recommendations that, as a matter of national importance, telegraphic communication between Porto Rico and the United States be maintained by a cable operated by the United States or by an American corporation. At present the island is reached only over the cables of an English corporation. He suggests the laying of a cable from Porto Rico to Santiago, Cuba, the cost of which is placed at $600,000.

General Greely furnishes a new explanation of the failure of Admiral Dewey to use the cable from Manila to Hong Kong after it had been cut, saying that in obedience to the demands of the government of Spain upon the Eastern Extension Telegraph Company, which was receiving a subsidy, the cable was officially sealed at Hong Kong and remained dead during the entire war. When the United States laid a cable of its own from Manila to Cavité, the same company questioned this country's rights to lay cables in the Philippines. They further demanded absolute cable rights, which were promptly refused. This company abandoned its stations at Iloilo and elsewhere in the Philippines, and later sought to have the United States acknowledge the legality of the Spanish concessions and continue the same. General Greely made an unfavorable report on all of these applications and was eventually supported by the Administration.

General Greely explains the necessity for extended cable lines in the Philippines, and adds that it is only a matter of time when Luzon shall be connected with Formosa (whence cables now run to Japan and China) by an international cable, which would not be much over 200 nautical miles in length. This would insure an independent connection between the Philippine Islands, Japan and the Asiatic mainland, which is now only available telegraphically over a short cable of about 600 miles of the Eastern company, where the charges are three times as great as between the United States and Europe. He then refers to the proposed Pacific cable, saying:

"In order to join closer together the United States and its Pacific colonies it is essential to span the Pacific by a submarine cable, as recommended by the President to Congress in his special message of February 10, 1899. The great value of such a cable is not alone for military purposes, but more especially for the fostering of industrial interests in the new colonies and in order to facilitate commercial operations."

The report advocates an international cable conference to consider the subject of the rights, privileges and immunities of submarine cable property in time of war. In view of the present enormous extension of submarine cable service throughout the world, aggregating in the British Empire alone an estimated cost of $30,000,000, such a conference could properly consider other international cable matters, among them the revision and adoption of an international cable code.

Automobile Club Run.

The Automobile Club of America had its first regular run on November 4, thirty-five vehicles being in line. The route was through various boulevards and avenues of New York city. At the head of the line were General Avery D. Andrews, president of the club, and Jefferson W. Seligman in an electric dos-a-dos trap. The procession did not have the right of way along the streets and avenues, but all kept well to the right-hand side.

Going up Fifth avenue the automobilers received applause from the spectators who fringed the sidewalks. The pace varied from eight to twelve miles an hour. One notable circumstance was that, although the machines kept fairly close together all the way up Fifth avenue and alongside of the Park, past many spirited horses, there was not a single runaway. There were in the run twenty-two electric vehicles, eight with gasoline motors, four with steam boilers and one gasoline tricycle.

An Automobile to Tow Canal Boats.

Work has commenced at Hartford, Ct., on an automobile designed to be used for towing canal boats on the Erie Canal. It is intended to have sufficient capacity to tow from six to ten canal boats at one time.

Trolley Consolidation in New Jersey.

The Jersey City, Hoboken & Paterson Street Railway Company, with an authorized capital of $20,000,000, has been incorporated. This is a consolidation of the following companies: Paterson Central Electric Railway Company, Saddle River Traction Company, Palisade Railway Company, White Line Traction Company, Paterson, Passaic & Rutherford Railway Company and the Paterson Horse Railway Company. These consolidated companies control the street car service of Hoboken, the line from Hoboken to Jersey City and the territory between Hoboken and Little Falls, in Passaic County. The company also controls stock of the North Hudson Company and the Paterson Railway Company, which companies will be operated separately, but in harmony. The incorporators are William C. Shanley, Peter Hauck, David Young, John W. Oberson, John M. Shanley, all of Newark, and Bird W. Spencer, of Passaic; Edward L. Young, of Jersey City; Philip Hexamer, of Hoboken; William J. Davis, of Harrison; James K. Corbiers, of Caldwell; H. M. Barrett, of Bloomfield; Frank A. Stillman, of Rahway; Warren S. Call, of Hoboken, and George W. Waite, of Jersey City. The new company has organized by the election of the following officers and directors: President, David Young; vice-president, John F. Shanley; treasurer. George W. Roe, all of Newark, and secretary, William C. Doubleday, of Jersey City; directors, William C. Shanley, William J. Davis, Bird W. Spencer, Peter Hauck, Jr., Edward L. Young, Philip Hexamer, James K. Corbiers, Halsey M. Barrett, David Young and John W. Oberson.

A New Automobile Trust.

It is proposed to form a corporation with a capital of $200,000,000 which will control the automobile business completely, including the manufacturing of the vehicles and all their parts, as well as their manipulation and control. It is also proposed to include in this corporation the company known as the Anglo-American Vehicle Company, which was incorporated at Dover, Del., last week, with a capital of $75,000,000. It is rumored that among those interested in the proposed new corporation are Studebaker Brothers, the large carriage manufacturers of South Bend, Ind.; Eleazer Kempshall, an inventor of rubber tire improvements, and Homer W. Hedge, the secretary of the lately formed Automobile Club of America.

PERSONAL.

Mr. Morris W. Mead, chief of the Bureau of Electricity of Pittsburgh, Pa., made a brief visit to New York city last week.

Mr. J. F. Blauvelt, of the New England Butt Company, Providence, R. I., visited New York city and Philadelphia last week.

Mr. E. M. Scribner, of the Bryant Electric Company, Bridgeport, Ct., was among last week's out-of-town visitors to New York city.

Mr. William I. Buchanan has resigned as United States minister to the Argentine Republic, and has accepted the position of director-general of the Pan-American Exposition to be held at Buffalo, N. Y., in 1901.

Professor Henry S. Carhart, of the department of physics of the University of Michigan, who is absent on leave, is at the Physical Technical Institute, Berlin. He is comparing the electro-motive force of the standard Clark cell with that of the standard cell of the Institute.

Mr. Andrew C. Shaw, well known in the electrical newspaper field, sailed last Saturday for England, where he will make his residence hereafter. The evening before his departure a number of his New York friends tendered him a dinner and presented him with a cane as a mark of their esteem.

Mr. William B. Wreaks, who is well known as an engineer and salesman connected with the New York office of the Westinghouse Electric and Manufacturing Company, wa married to Miss Mary Perry in New York city on October 21. The ELECTRICAL REVIEW extends its congratulations.

Mr. E. G. Breuckman, general manager of the Imperial Electric Company, of St. Louis, Mo., was a visitor in New York last week, with headquarters at the Waldorf-Astoria. Mr. Breuckman reports that the Imperial Electric Company is succeeding finely in supplying electric light and power to the citizens of St. Louis, and is rapidly acquiring a large business.

Mr. Charles A. Moore, of Manning, Maxwell & Moore, the widely known railway and general machinery supply house of New York, has been elected a director of the Liberty National Bank, of this city. Mr. Moore is one of the most enterprising business men of the metropolis, is a close friend of President McKinley, and the Liberty bank is to be congratulated on his entering its directorate.

THE NATURE OF PHYSICAL LAWS.

BY PROFESSOR J. H. POYNTING, F. R. S.

The subjoined extracts from an address to the Mathematical and Physical Section of the British Association for the Advancement of Science, while dealing with the concepts of pure science, have in them so much of the common-sense of applied science that they can not fail to interest the worker in the field of electrical engineering.

The range of the physicist's study consists in the visible motions and other sensible changes of matter. The experiences with which he deals are the impressions on his senses, and his aim is to describe in the shortest possible way how his various senses have been, will be, or would be affected.

His method consists in finding out all likenesses, in classing together all similar events, and so giving an account, as concise as possible, of the motions and changes observed. His success in the search for likenesses and his striving after conciseness of description lead him to imagine such a constitution of things that likenesses exist even where they elude his observation, and he is thus enabled to simplify his classification on the assumption that the constitution thus imagined is a reality. He is enabled to predict on the assumption that the likenesses of the future will be the likenesses of the past.

His account of Nature, then, is—as it is often termed—a descriptive account.

Were there no similarities in events, our account of them could not rise above a mere directory, with each individual event entered up separately with its address. But the similarities observed enable us to class large numbers of events together, to give general descriptions, and indeed to make, instead of a directory, a readable book of science, with laws as the headings of the chapters.

These laws are, I believe, in all cases brief descriptions of observed similarities. By way of illustration let us take an example:

The law of gravitation states that to each portion of matter we can assign a constant—its mass—such that there is an acceleration towards it of other matter proportional to that mass divided by the square of its distance away. Or all bodies resemble each other in having this acceleration towards each other.

And, generally, when a law is expressed by an equation, that equation is a statement that two different sets of measurements are made, represented by the terms on the two sides of the equation, and that all the different cases resemble each other in that the two sets have the constant relation expressed by the equation. Accurate prediction is based on the assumption that when we have made the measurements on the one side of the equation we can tell the result of the measurements implied on the other side.

If this is a true account of the nature of physical laws, they have, we must confess, greatly fallen off in dignity. No long time ago they were quite commonly described as the Fixed Laws of Nature, and were supposed sufficient in themselves to govern the universe. Now we can only assign to them the humble rank of mere descriptions, often tentative, often erroneous, of similarities which we believe we have observed.

The old conception of laws as self-sufficing governors of Nature was, no doubt, a survival of a much older conception of the scope of physical science, a mode of regarding physical phenomena which had itself passed away.

Even now these early stages in the history of thought can be traced by survivals in our language, survivals due to the ascription of moral qualities to matter.

Thus, gases are still sometimes said to obey or to disobey Boyle's law as if it were an enactment for their guidance, and as if it set forth an ideal, the perfect gas, for their imitation. We still hear language which seems to imply that real gases are wanting in perfection, in that they fail to observe the exact letter of the law. I suppose, on this view, we should have to say that hydrogen is nearest to perfection; but then we should have to regard it as righteous overmuch, a sort of Pharisee among gases which overshoots the mark in its endeavor to obey the law. Oxygen and nitrogen we may regard as good enough in the affairs of every-day life. But carbon dioxide and chlorine and the like are poor sinners which yield to temptation and liquefy whenever circumstances press at all hardly on them.

There is a similar ascription of moral qualities when we judge bodies according to their fulfillment of the purpose for which we use them, when we describe them as good or bad radiators, good or bad insulators, as if it were a duty on their part to radiate well, or insulate well, and as if there were failures on the part of Nature to come up to the proper standard.

These are, of course, mere trivialities, but the reaction of language on thought is so subtle and far-reaching that, risking the accusation of pedantry, I would urge the abolition of all such picturesque terms. In our quantitative estimates let us be content with "high" or "low," "great" or "small," and let us remember that there is no such thing as a failure to obey a physical law. A broken law is merely a false description.

Concurrently with the change in our conception of physical law has come a change in our conception of physical explanation. We have not to go very far back to find such a statement as this, that we have explained anything when we know the cause of it, or when we have found out the reason why—a statement which is only appropriate on the physical view. Without entering into any discussion of the meaning of course, we can at least assert that that meaning will only have true content when it is concerned with purpose and will. On the purely physical or descriptive view, the idea of cause is quite out of place. In description we are solely concerned with the "how" of things, and their "why" we purposely leave out of account. We explain an event now when we know "why" it happened, but when we show "how" it is like something else happening elsewhere or otherwhen—when we can include it as a case described by some law already set forth. In explanation, we do not account *for* the event, but we improve our account *of* it by likening it to what we already knew.

For instance, Newton explained the falling of a stone when he showed that its acceleration towards the earth was similar to and could be expressed by the same law as the acceleration of the moon towards the earth.

He explained the air disturbance we call "sound" when he showed that the motions and forces in the pressure waves were like motions and forces already studied.

Franklin explained lightning when and so far as he showed that it was similar in its behavior to other electric discharges.

Here I do not fear any accusation of pedantry in joining those who urge that we should adapt our language to the modern view. It would be a very real gain, a great assistance to clear thinking, if we could entirely abolish the word "cause" in physical description, cease to say "why" things happen unless we wish to signify an antecedent purpose, and be content to own that our laws are but expressions of "how" they occur.

The aim of explanation, then, is to reduce the number of laws as far as possible, by showing that laws, at first separated, may be merged in one; to reduce the number of chapters in the book of science by showing that some are truly mere subsections of chapters already written.

To take an old but never worn-out metaphor, the physicist is examining the garment of Nature, learning of how many, or rather of how few, different kinds of thread it is woven, finding how each separate thread enters into the pattern, and seeking from the pattern woven in the past to know the pattern yet to come.

How many different kinds of thread does Nature use?

So far, we have recognized some eight or nine, the number of different forms of energy which we are still obliged to count as distinct; but this distinction we can not believe to be real. The relations between the different forms of energy, and the fixed rates of exchange when one form gives place to another, encourage us to suppose that if we could only sharpen our senses, or change our point of view, we could effect a still further reduction. We stand in front of Nature's loom as we watch the weaving of the garment. While we follow a particular thread in the pattern it suddenly disappears, and a thread of another color takes its place. Is this a new thread, or is it merely the old thread turned around and presenting a new face to us? We can do little more than guess. We can not get to the other side of the pattern, and our minutest watching will not tell us all the working of the loom.

To form such mental pictures we naturally choose the sense which makes such pictures most definite, the sense of sight, and think of a constitution of matter which shall enable us to explain all the various changes in terms of visible motions and accelerations. We imagine a mechanical constitution of the universe.

We are encouraged, in this attempt, by the fact that the relations in this mechanical conception can be so exactly stated, that the equations of motions are so very definite. We have, too, examples of mechanical systems, of which we can give accounts far exceeding, in accuracy, the accounts of other physical systems. Compare, for instance, the accuracy with which we can describe and foretell the path of a planet with

our ignorance of the movements of the atmosphere as dependent on the heat of the sun. The planet keeps to the astronomer's time-table, but the wind still bloweth almost where it listeth.

The only foundation which has yet been imagined for this mechanical explanation—if we may use "explanation" to denote the likening of our imaginings to that which we actually observe—is the atomic and molecular hypothesis of matter. This hypothesis arose so early in the history of science that we are almost tempted to suppose that it is a necessity of thought, and that it has a warrant of some higher order than any other hypothesis which could be imagined. But I suspect that if we could trace its early development we should find that it arose in an attempt to explain the phenomena of expansion and contraction, evaporation and solution. Were matter a continuum we should have to admit all these as simple facts, inexplicable in that they are like nothing else. But imagine matter to consist of a crowd of separate particles with interspaces. Contraction and expansion are then merely a drawing in and a widening out of the crowd. Solution is merely a dispersal from the outskirts. The most evident properties of matter are then similar to what may be observed in any public meeting.

For ages the molecular hypothesis hardly went further than this. The first step onward was the ascription of vibratory motion to the atoms to explain heat. Then definite qualities were ascribed, definite mutual forces were called into play to explain elasticity and other properties or qualities of matter. But I imagine its first really great achievement was its success in explaining the law of combining proportions, and next to that we should put its success in explaining many of the properties of gases.

(To be concluded.)

Resistance of Nickel Wire.

To the Editor of Electrical Review:

Can you give me any information as to the comparative resistances of the various nickel wires now on the market for resistance coils in competition with German silver? I would be obliged if you can refer me to any books or papers giving the results and actual measurements, as I have not been able to find any figures on nickel-steel wire in any of my books. It is, of course, important to know the percentage of nickel contained. J. S. B.

New York, October 31.

EMERGENCY WORK ON A STREET RAILWAY.

CHANGING A CABLE ROAD TO THE CONDUIT ELECTRIC SYSTEM.

On Sunday, October 29, 1899, the main line of the Third Avenue Railroad in New York city was for the first time traversed by an electric car. The difficulties attending the inauguration of the underground system of electric conduction on this railway—formerly a cable road—are perhaps amusing in the retrospect, but were doubtless of considerable seriousness to those engaged in the work at the time. In the Electrical Review for October 18, 1899, appeared a description of the temporary station at 65th street and Third avenue, which is not yet in operative condition. Some weeks ago the 125th street line, belonging to the same railway system, but which crosses Third avenue at a right angle, was put in operation, power being supplied from a temporary power house at 130th street and Amsterdam avenue, where eight 500-horse-power direct-coupled generating units are installed.

The system of feeders laid along Third avenue, northwards, from 65th to 130th street, was designed for distribution of current from the southward point. Of the four pairs of heavy copper feeders which extend northward from 65th street only one goes so far as 125th street, and connection was necessarily made to this for the purpose of carrying the current from the temporary power house down Third avenue. It was not attempted to operate further southward than 65th street.

Late Saturday night the work of withdrawing one of the cables in the conduit was commenced. This cable was laid on pulleys situated fifteen feet apart, and a reserve cable lay in the bottom of the conduit. Seeing that the cable grips formerly ran in position not different from that of the current collecting shoe of the electric system, the conductor rails could not be placed in permanent position until the withdrawal of the cable and the stoppage of cable traffic. Consequently, one line of them on one side was lined up to its proper position three inches from the centre of the conduit, while the castings supporting the rail on the other side were provided with slotted holes, so that temporarily that rail could be thrown back under the arch of the conduit roof out of the way of passing grips. Hence, the first and most necessary work was to put as many men as possible upon the task of lining up this rail to a position facing the other, and six inches distant from it. Inasmuch as the work was done at night by inexperienced men and in a tremendous hurry, the distance apart of the rails varied all the way from three inches to the full width of the conduit. Immense difficulty was also had in splicing cables and making connections, as men who were employed upon this work were at the time of the change-over nearly dead from fatigue and unable to work intelligently. The changes were, however, finally made, and early on Sunday morning a car started down from 125th street. The first time its plough struck a place where the conductor rails were too far apart, naturally an immense arc was started, which resulted in burning the rails and the plough and causing brilliant but unexpected fireworks in the street. At other places where the rails were too close together the plough jammed and stuck. The youthful inhabitants of the district through which the line runs had discovered on Sunday morning that pyrotechnical displays could be had by lowering hoop iron into the conduit and wiggling it around until something happened. The happening was generally sufficient to fill the small boy with glee, but as generally resulted in the destruction of one or two lengths of the conductor rails, which were burned into such condition that the plough could not pass them. Notwithstanding these difficulties, in thirteen hours from the time the cable was withdrawn, electric cars were running on the new section and have been in continuous operation ever since. It is expected that the section from 65th street southwardly to the Post Office will be opened for traffic by electric cars within two weeks.

An amusing incident is related by one of the engineers in charge. It appears that Italian laborers of the most dense and extraordinary ignorance were employed upon the work by the contractor, and it seemed that it was not possible for them to understand the difference between a rail charged with electricity and an ordinary piece of iron. One day up at the terminus at 130th street a gang of five Italians was working in a manhole when one of their number nonchalantly laid a crowbar across the conductor rails. Naturally, a blinding arc of great violence was immediately started, and the five children of sunny Italy are said to have been last seen in the vicinity of the Harlem River going North with great velocity. They have not even returned to receive the pay due them.

The obstacles in the way of starting the new road were of the annoying kind that are so frequently encountered when engineering work is of necessity rushed to completion, and the greatest credit is due to Dr. Louis Duncan, the chief engineer of the road, for his successful solution of the difficult problems which suddenly presented themselves in the inauguration of the electric service.

AUTOMOBILE NEWS.

The Commissioners of the District of Columbia have ruled that a steam engineer's license is necessary for operating, on the streets of Washington, automobiles run by steam generated from gasoline, benzine or other fuel. Operators of electromobiles are not required to take out a license.

The horses of Queen Victoria's royal stable have been educated so as not to fear automobiles. They were led and then driven around a stationary vehicle, and finally the vehicle was run between the horses as they stood near each other. It is said they behaved very well, and that the best bred horses cared the least about the automobiles.

Mr. Winslow E. Buzby took his electromobile into Central Park one day last week for the purpose of testing the ruling of the Park Commissioners that automobiles should not be allowed in Central Park. He succeeded in getting himself arrested for the purpose of making a test case. Mr. Buzby insists that his vehicle is a pleasure carriage and that the rules of the Park Board permit pleasure carriages to enter Central Park. He has ridden over 14,000 miles in his electromobile in three years. Mr. Buzby is a lawyer and a member of the Automobile Club, and proposes to have the rights of owners of automobiles in New York city definitely settled.

The Army and Wireless Telegraphy.

The proposed experiments by the Signal Corps of the United States Army with the Marconi system of wireless telegraphy have been abandoned for the present, owing to the fact that Mr. Marconi has made what the War Department considers exorbitant demands from the government for the use of his system. The War Department, it is said, fears there will be trouble over Mr. Marconi's patents, and the government does not wish to become involved in such controversies.

Telephone News .....and Comment

The Wisconsin Telephone Company is going to expend $10,000 in the next few weeks in improving the system at Ashland, Wis.

Stockholm papers of recent date express great satisfaction with the visit of President Sabin, of the Pacific Coast Telephone Companies, and President Glidden, of the Erie telephone system, who are visiting Sweden for the purpose of inspecting its telephone system.

Cleveland, Ohio, is soon to have five new telephone exchanges, making nine in all, including the main exchange. The Cleveland Telephone Company now has about 40,000 miles of wire in that city, about equally divided between overhead and underground.

The barbed-wire telephone system around LeGrande and Merced, Cal., has proved such a success and gives promise of so much growth that it is said the owners have received an offer from the Sunset Telephone and Telegraph Company looking to a mutual business arrangement.

The instrument statement of the American Bell Telephone Company for the month ended October 20, 1899, shows:

	1899.	1898.	1897.
Gross output	50,861	33,639	23,131
Returned	18,044	11,823	7,145
Net output	32,817	21,816	15,986
Since December 20:			
Gross output	539,598	278,363	185,874
Returned	163,271	123,082	76,251
Net output	376,327	158,281	109,623
Total outstanding	1 501,577	1,077,402	883,472

The Maryland Telephone and Telegraph Company, of Baltimore, Md., has secured locations for three substations, and will erect a building on each to accommodate 1,000 telephones. Mr. Joseph Evans Sperry is preparing plans for the buildings, which are to cost about $5,000 each. With the new substations the company will have a capacity for 7,000 'phones.

The November, 1899, issue of the Cincinnati Bell Telephone Directory has come to hand. It is of the usual convenient character, and its increasing bulk indicates a satisfactory growth of subscribers. The company is trying the experiment of reducing the rates charged for local tolls from city pay stations from ten to five cents for each five minutes' conversation. It is understood that this is to avoid the unauthorized use of subscribers' telephones by non-subscribers.

The Chesapeake & Potomac Telephone Company has placed on record a deed of trust for $1,500,000 to the American Surety and Trust Company, of Washington, D. C. The trust embraces all of the realty of the company in Washington and Baltimore, as well as its lines, equipments, franchises, licenses and all other holdings in the District of Columbia and Maryland. The obligation is, however, subject to a prior deed of trust for $600,000, of which there are in bonds $500,000 outstanding at present. These bonds mature on June 1, 1901, and it is the intention of the company to use a portion of the money obtained from the sale of the present issue of bonds to take up the old ones.

Complimenting a Wide-Awake Advertiser.

The manager of the Okonite Company, New York, Mr. W. L. Candee, has received from a large customer the following indorsement of his company's recent page announcement, apropos of yachting, that appeared in this journal:

"It is not often that I take the time, for I am too busy generally, to write to you or any one else in regard to his advertisements, but I do think that you, or whoever is the originator of the idea, are particularly to be congratulated over the striking, up-to-date and unique page which you presented in the ELECTRICAL REVIEW last week. Your announcements in that paper are generally particularly attractive and impressive, but, in my opinion, you have on this occasion excelled yourself. I shall be over in a few days to leave an order with you on the strength of this announcement. I have sailed over many seas on the good ship Okonite, and it has never failed me yet.

"Shiver her timbers, but a rival never 'crossed' her bows; her passengers have never feared going 'aground,' and ordinary 'resistances' to her are of no consequence."

October 18, 1899.

Another Big Automobile Company.

The Anglo-American Vehicle Company, authorized capital, $75,000,000, has been incorporated at Dover, Del. It is reported that the company proposes to combine into one immense concern all the leading English and American automobile manufacturers, and its headquarters will be in New York. The incorporators are H. B. Twyford, of Wyndley Grange, England; Earnest Martin, of New York, and James Virdin, of Dover.

Wall Street and the Electrical Stock Market.

Trading in Wall street during the week just closed has been remarkably active and prices have continued to rise, although in a somewhat irregular way. The conspicuous features of the week have been of a character to restrict activity and to induce caution in the market. They comprise the active and close money market, the unsatisfactory progress of the South African war and the near approach of the state elections with their bearing on the presidential campaign of next year. However, as stated above, values have continued to increase.

On the New York Stock Exchange General Electric closed the week at 121¾ bid and 123 asked, a gain of ½ point for the week. Metropolitan Street Railway, of New York, closed at 196 bid and 196¼ asked, a loss of 2¼ points for the week. Third Avenue Railroad, of New York, closed at 155 bid and 157 asked, a loss of ¾ of a point for the week. Brooklyn Rapid Transit closed at 88 bid and 88¼ asked, a gain of 2⅛ points for the week.

On the Boston exchange American Bell Telephone closed at 368 bid and 370 asked, a loss of 3 points for the week. Erie Telephone closed at 116 bid and 117 asked.

On the Philadelphia exchange Union Traction closed at 38⅜ bid and 38½ asked, indicating no change for the week.

On the curb or outside market in New York Electric Vehicle closed at 70 bid and 74 asked, a loss of 7 points for the week. Electric Boat closed at 19 bid and 21 asked, a loss of 1 point in the bid price for the week.

Wall Street, Nov. 4.

The Two Extremes of Power Transmission.

The contents of the New York ELECTRICAL REVIEW are more than usually interesting this week. The most important article will need a separate note. For the rest it is pointed out that for man-of-war work, electric power distribution is less disastrous in case of severance of the channel of transmission, and much more easily and quickly repaired than either steam or hydraulic methods. (Surely mechanical gearing like chains, rods, shafts and belts, might equally well have been added to the list.) The Snoqualmie Falls aluminum transmission line is also described, and apparently from information gathered, not information supplied. The pressure is 30,000 volts, but the only indication of the amount of power to be transmitted, is that the four water-wheels are each of 3,000 horse-power. The current passes from the power house over twelve aluminum wires, divided between two lines of poles. These two lines run twenty miles to Renton, whence half go to Seattle and half to Tacoma. At Renton there is a switchboard substation.

The Seattle lines contain about 67,000 pounds of wire, and the Tacoma lines 72,000. The line is approximately .26 inch in diameter for the Seattle circuits and .23 inch in diameter for the Tacoma circuits. It is carried on porcelain insulators, which are 4½ inches high and 6½ inches in diameter, weighing 4 pounds each.

There are no soldered joints, aluminum apparently successfully resisting that indignity, but the line conductors are spliced with a joint, which consists of a flattened aluminum tube nine inches long, with walls one-sixteenth of an inch thick, which tightly encloses the two wires. The whole is given three complete twists by special clamping tools, and the joint is complete. Practically all that is stated as to the generating plant is that the turbines and machines are underground, 250 feet below the water level. The water comes down a shaft in a steel pipe, and rejoins the river through a tunnel. There is no information as to phases, or the pressure of generation, or the arrangement of the step-up and step-down transformers.—*London Lightning.*

DIVIDENDS.

The Quincy & Boston, Mass., Street Railway Company has declared a regular semi-annual dividend of $3.50 per share.

The West Chicago Street Railway Company has declared a regular quarterly dividend of 1¼ per cent, payable November 15.

The directors of the New England Telephone and Telegraph Company have declared a regular quarterly dividend of $1.50 per share, payable November 15.

The Sprague Electric Company, of New York city, has issued Catalogue No. 75, devoted to interior conduit. This catalogue is from the Orr Press and is of the usual high standard of Sprague publications. It describes the company's complete system of interior conduit for all purposes, and contains descriptions and illustrations of the tools required for installing this conduit. The details are thoroughly explained and the illustrations help to afford an easy understanding of the text. A convenient telegraph code for ordering by wire is comprised in the catalogue, which may be had free for the asking.

An Unique Electric Generating Plant.

One of the most extraordinary of electric lighting plants is one now operating in the municipal pumping station at Columbus, Ohio.

The Director of Public Improvement of that city, finding that the pumping capacity of the station was greater than the city's needs required, cast about him for some means of utilizing this surplus capacity, and hit upon the idea of using the surplus water that the pumps were capable of supplying to drive water-wheels direct-coupled to dynamos, the current thus generated being used for supplying light to the surrounding district by means of arc lamps.

Specifications were accordingly prepared and submitted to the leading water-wheel manufacturers, with the result that the plan proposed by the American Impulse Water-Wheel Company was accepted as the one giving the best promise of fulfilling the requirements, and the contract was accordingly signed.

The specifications were rigid in their requirements with regard to both efficiency at all loads and to speed governing under sudden and great changes of load. The difficulty of the problem was also much enhanced by reason of the very limited space available for the machines and piping, and by the high speed required for direct-connection to the Western Electric Company's 100-light arc dynamo. This speed, 650 revolutions per minute, necessitated the use of impulse wheels only eighteen inches in diameter, and in order to obtain 110 horse-power from each unit, eighteen nozzles were required. These were arranged with six runners, three nozzles to each runner, since a larger number of nozzles per runner would have reduced the efficiency below the guarantee.

The use of contracting nozzles to keep up the efficiency at light loads was prohibited by the great cost and complication of so large a number of contracting nozzles. Ordinary butterfly valves were accordingly used, and the cam mechanism for operating these valves arranged to actuate them one after the other, instead of all together, as had previously been common practice. As a result of this ingenious arrangement all the valves in operation, except one, would be wide open and working, therefore, at their maximum efficiency, and thus the low efficiency of a partly closed butterfly valve would have an almost inappreciable effect in lowering the total jet efficiency of the machine, and at six values of the load, when a valve had just completely closed, would have no such effect at all.

The rigid requirements with regard to efficiency having been thus complied with, the problem of speed-governing was next attacked. The small diameter of the runners, rendered necessary by the high speed, so far reduced their momentum that it was necessary to add a heavy flywheel in order to keep the variations of speed within the guaranteed limits. The high speed also prohibited the use of the ordinary cast-iron flywheel. The wheel was accordingly made with a steel rim, shrunk on to a cast-iron web. The governor is the ordinary mechanical relay actuating six cams, the connection between the cam shaft and the governor being by gear and pinion.

The water chambers were cast in two pieces, the nozzles being bolted on so as to come in exactly the right position with reference to the runners. This large casting rested on the cast-iron base and was bolted to it. The casing was made of riveted boiler iron, in two parts, the upper half being provided with eye bolts for lifting. The details of the piping, receiver, etc., are clearly enough shown in the accompanying illustrations.

The fact that this plant has now been running for over twelve months without trouble of any kind, and to the entire satisfaction of the engineer in charge, reflects great credit upon the management of the American Impulse Water-Wheel Company, and especially upon their consulting engineer, Mr. Thorburn Reed, to whom was intrusted the task of meeting and overcoming the difficulties presented by this new departure in water-wheel engineering.

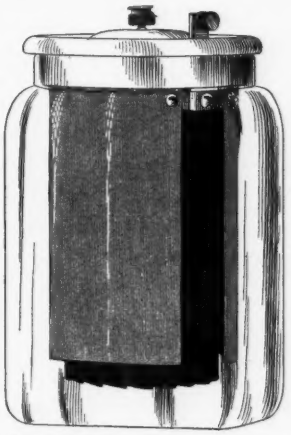
A Large Foreign Contract.

The Glasgow (Scotland) Corporation Tramways, which are owned by the municipality, have just contracted with the National Conduit and Cable Company, of New York, for two million feet of wrought iron, cement-lined, three-inch conduit pipe for their feeders. The British headquarters of the Conduit company are at 23 College Hill Chambers, London, E. C., and Mr. George J. Jackson, secretary of the company, is spending a few months there.

It is announced that this office has secured a large number of export contracts, aggregating about four million feet of conduit exclusive of the Glasgow order. The new street railway installation in that city will be almost wholly American, the engines, dynamos, conduits and many other parts of the system coming from the United States.

A Simple Sal Ammoniac Battery.

The battery cell, shown herewith, represents the simplest design that is consistent with efficient operation. It is intended for open-circuit work and is especially adapted for gas lighting, gas-engine sparking, bell ringing, etc. The zinc is of a cylindrical shape, and surrounds a porous fluted carbon cylinder which is filled with a depolarizing compound in the shape of granules. The fluid used is the familiar solution of sal ammoniac in water. This cell, of which the trade name is "Hercules," is made by the Peru Electric Manufacturing Company, of Peru, Ind.



A Simple Sal Ammoniac Battery.

Electricity on the New York Elevated Railroads.

Mr. Russell Sage announced last week to the directors of the Manhattan Railway Company that Vice-President Skitt had submitted the plans that have been decided upon for the change of motive power to electricity on the lines of the company's system. Mr. Sage said that the road would save between 25 and 30 per cent in operating expenses after the change was made. The contracts for the engine and boiler plants have been awarded, and will be completed and delivered in about a year. None of the electrical contracts has been placed.

Lieutenant H. H. Eames, of the Columbia and Electric Vehicle Company, of Hartford, Ct., was among recent visitors to New York city.

Unsatisfactory Tests of the Marconi System of Telegraphy.

During two days of last week the United States Navy carried on tests of the Marconi system between the cruiser New York and the battleship Massachusetts at sea off the New Jersey coast. The commission in charge of the test consisted of Lieutenant-Commander J. T. Newton, Lieutenant John B. Blish and Lieutenant F. G. Hill. Mr. Marconi was aboard the New York where his apparatus were installed on the after gun-deck. Through a wooden hatch a wire was led to the top of the main mast in a way that is now well known. A similar contrivance was erected on the Massachusetts, and at the Highlands of Navesink the mast used during the yacht races was also brought into play. It happened that the days of the test were marked by a severe northeast gale, accompanied by a heavy sea, and the tests were very unsatisfactory. The sprit to which the wire was attached on board the New York had to be taken down on account of the violence of the wind, while the insulation of the vertical wire on the Massachusetts was destroyed. The next day a heavy wave came aboard the New York, flooding the room in which the instruments were located and, of course, doing considerable damage to insulation, etc. The operator in charge of the installation aboard the Massachusetts suffered so severely from sea-sickness that he was unable to work the instruments. It was attempted to direct signals or, at least to receive directed signals during these trials, the method used being to suspend alongside of the vertical wire a strip of wire cloth which could be brought between it and a disturbing station whose message it was not desired to receive. This did not have a fair trial, however, because of the gale which wrecked it. Just before the tests were begun Mr. Marconi formally notified the commission in charge of the tests that he would not be able to give a demonstration of his syntonizing system, as he had not yet protected it fully by patents, and was not provided with the necessary material and instruments. The tests were continued with greater success on the days following the storm. The extreme limit to which the signals were sent on these trials was thirty-six miles.

On November 2 further tests, somewhat more successful, were made with the torpedo boat Porter as one of the stations. Lieutenant-Commander Newton was in charge of the experiments on the Porter.

The Properties and Applications of Aluminum.*

MM. Ditte and Moissan have recently contributed to the French Academie des Sciences important papers on the above subject. Owing to the gradual extension of the field of utilization of this metal, we think these papers worthy the attention of our readers, and we therefore present abstracts of them below :

THE PROPERTIES OF ALUMINUM.

A. Ditte. Comptes Rendus. January 23, 1899.

In a previous article the author had proved that aluminum is readily attacked by many reagents, and that its apparent stability is due to a thin adhesive film of alumina ($Al_2 O_3$), or of gas. When the solvent used is one capable of dissolving alumina, corrosion occurs rapidly, since the protective coating is being continually removed. The presence of oxygen or of carbonic acid is required in order to provide the necessary supply of oxygen. In sea water, the same reaction occurs, the carbonic acid of the air being in this case the oxidizing agent. In the water of the Seine itself, aluminum is slowly corroded, the action being most marked at the point where the air and water meet. In either case, the attacked metal covers itself with a film of alumina, which may retain particles of other salts. If these impurities are allowed to remain in contact with the aluminum, the attack will slowly continue, and the metal will become disintegrated, even after removal from the water. To prevent this, it is necessary to wash the aluminum when taken from the water, with a solution capable of removing the last traces of alkaline matter from its surface. The "sickness" of copper investigated by M. Berthelot, is a similar phenomenon to this progressive disintegration of aluminum. In the case of copper, the successive formation and decomposition of a small amount of cuprous oxide is the cause of the evil; in the case of aluminum a similar series of changes of aluminum hydrate brings about disintegration and decay.

THE PROPERTIES AND APPLICATIONS OF ALUMINUM.

A. Ditte. Comptes Rendus. March 27, 1899.

The author states that two qualities of aluminum were employed in his experiments. The first was sheet metal used for the bodies of bowls, plates, saucers, saucepans, measures, etc., and contained 96 per cent aluminum, 3 per cent copper and 1 per cent of iron, silicon, carbon. The second grade of metal was used for the rings, links, handles, etc., of the above articles, and contained 93 to 94 per cent aluminum, 5 to 6 per cent copper, and 1 per cent of iron, silicon and carbon.

These alloys, if maintained for a short time at a red heat, and then plunged into water, change in physical structure. They become granular, and the surface of the metal is found to be covered with fine cracks.

If immersed in a 2 per cent solution of sulphuric acid, the action of the acid is more intense when preheating has occurred, and the surface of the metal covers itself with a black deposit of copper.

A 2 per cent solution of an alkali carbonate, or a solution of common salt containing 8 grammes NaCl per litre, rapidly attacks these alloys of aluminum at the ordinary temperature, and a coating of aluminum hydrate, $Al(OH)_3$, is produced upon the metal. If a polished plate of the metal be immersed in either of these solutions, it quickly loses its polish, and becomes coated with a thin film of crystalline alumina.

The effects of similar action are seen in the aluminum vessels, etc., returned from Madagascar. A piece of aluminum plate, a fragment of a portable water-tank, had its external surface practically uninjured, while its interior surface was found to have undergone physical change and to have become lamellar and fragile. Under the microscope it was seen to be strongly corroded and to be covered with aluminum hydrate.

This inner surface of the plate was more rapidly attacked by sulphuric acid and sodium carbonate solutions than the outer surface, and a metallic crystalline powder was detached. If a thin aluminum sheet be immersed in distilled water, the latter will gradually become alkaline, owing to the transfer of small quantities of aluminum hydrate, sodium and chlorine, from the metal to the water; and the combined action of air and of water, containing possibly chlorine salts in solution, had, no doubt, started the disintegation of the inner surface of the metal used for these water-tanks. Once begun, the action would be self-supporting.

All the other Madagascar articles examined by the author (plates, measures, saucepans) showed signs of similar disintegration. The action of water and air on the cooking vessels was probably intensified by the materials cooked in them. The electromotive force set up by the different solubilities of copper and aluminum would also assist the attacking agents, and accelerate disintegration. In sea water a copper aluminum couple gives an electro motive force of between .486 and .525 volt.

THE APPLICATIONS OF ALUMINUM.

H. Moissan. Comptes Rendus. April 10, 1899.

The author states that Ditte regards the results obtained in his experiments as relative to pure aluminum, whereas his analysis show that the metal used by him was not first grade aluminum.

The metal produced to-day at the works of Herault and of Secretan is almost pure, and contains neither sodium nor carbon. Tests are giving showing that while in 1893 the purest grades of aluminum obtainable contained between .93 and 1.64 per cent silicon, and between .32 and 1.66 per cent iron, the corresponding percentages of these two impurities in the metal of the present date are .02 to .13 per cent silicon and .12 to .32 per cent iron. This improvement in quality is chiefly due to M. Secretan's modifications of the Hall process.

The water tanks used in Madagascar were mounted on iron, and this fact explains their corrosion. As a set-off to the statements by Ditte that all the aluminum articles used in Madagascar which he has examined are corroded, Moissan states that he has seen numerous articles from that campaign which are practically unattacked, although bent out of shape and blackened with use. (Some of these articles were exhibited at the Academie des Sciences.) The state of the articles examined by Ditte may be due to their having been in contact with sea water in the hold of the vessel in which they were returned. Quotations are given from reports by regimental officers, all in favor of aluminum for camp outfits. The advantages of the metal for military service, as compared with tinned iron, are :

1. Lightness; each soldier can carry 800 grams weight extra of ammunition.

2. No poisoning occurs from defective tinning.

3. No soldering of the vessels is required, as these are stamped out of sheet metal.

As regards Ditte's tests made by heating the metal and plunging it into cold water, such treatment would destroy any tinned iron utensil. The author has used aluminum in his own household for cooking purposes for three years, and these vessels are still in good condition; nor do they owe their preservation, as suggested by Ditte, to a protective coating of grease and dirt. A large hotel in Paris has a similar experience of one year with aluminum cooking utensils.

The advantages of aluminum may be summed up as (1) lightness; (2) an innocuous oxide; (3) capacity for being stamped.

The author closes by hinting that had M. Ditte, lived in another age, he would have been found condemning iron, on account of its readiness to form an oxide and to rust on exposure to the air.

THE APPLICATIONS OF ALUMINUM.

A. Ditte. Comptes Rendus. April 17, 1899.

A reply to the previous contribution by Moissan. The author states that he has taken note of the impurities in aluminum in his experiments. These impurities remain on the surface of the metal when it is attacked, and by breaking the continuousness of the layer of gases, they render the metal more liable to disintegration. In the course of his investigations he has examined not only the lower grades of aluminum, but also aluminum produced by M. Secretan in 1898, *i. e.*, the purest offered as a commercial product at that date.

With regard to the water tanks used in Madagascar, copper was purposely used to strengthen the metal employed for these, and the results of his examination of the returned fragments confirmed the results of his laboratory experiments with such alloys of copper and aluminum. The vessels exhibited by him at the Academie des Sciences were not returned in the hold of a vessel, or in contact with sea water, for no traces of chlorine or chlorides could be detected on their surface. M. Moissan has presented to the Academie articles from Madagascar in good condition; the author has presented others that show considerable corrosion. The obvious conclusion that should be drawn is, that vessels of aluminum have a long or a short life, according to usage and circumstances.

The author has not made personal trial of aluminum cooking utensils, but has used forks and spoons made of the metal. These were washed daily with a solution of sodium carbonate to remove the grease, and, under this treatment, they speedily lost their polish and became pitted and rough.

All the articles exhibited to the members of the Academie (including those exhibited by M. Moissan) have been greasy, and to this layer of grease some of them undoubtedly owe their preservation.

The author agrees with Moissan when he says that "chaque application de ce metal demande une étude speciale, longue et delicate," and states that he himself has recommended aluminum to the army authorities as the most suitable metal for water bottles, and has suggested improvements in the design of such vessels in order to facilitate their mechanical cleaning.

* The (London) *Electrical Review.*

Electric Searchlights for the New York Fire Department.

The New York Fire Department will soon have as a part of its equipment a complete electric searchlight plant on wheels, which will attend fires with the other apparatus, and it is expected will perform an important part in saving life and property. The searchlight will be used to illuminate dark parts of the street and aid firemen in laying hose, erecting ladders and also to light up the fronts of buildings where people may be in danger and to throw light into the buildings themselves to aid the firemen in their work. The apparatus will resemble a fire engine in appearance and will consist of a boiler, a direct coupled engine and dynamo and two searchlights, each with an eighteen inch projecting lens. The lights can be used either from the machine itself or carried to any convenient point, connection being maintained by means of flexible cables.

FOREIGN ELECTRICAL NOTES.

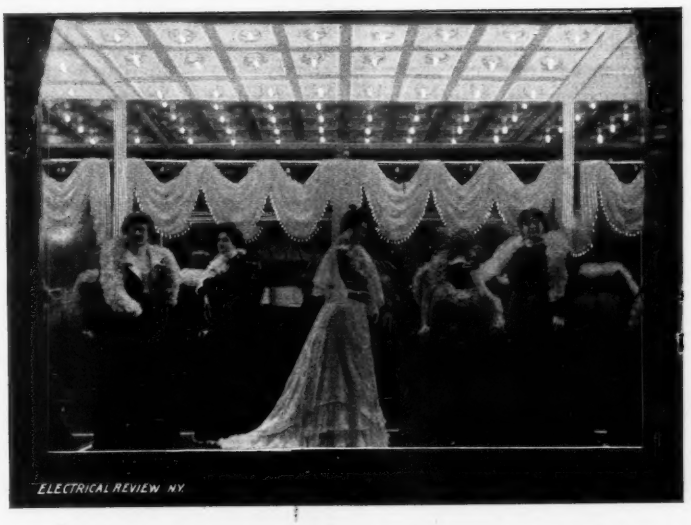
Visitors from your side of the Pond will hail with joy the news that the Thames Embankment is really to be lighted by electricity. It is a feat which has been debated these many years; in fact, an attempt to accomplish it was made some twenty years ago, the ancient Jablochkoff system being the one used. But the system was not a success; the conservative instincts of the nation demanded a reversion to the time-honored illuminant of gas, and the nation got its way. A row of "dirty little gas-jets" replaced the discredited electric light, and the Embankment after dark became one of the most dangerous spots in London. Then an arc lamp was placed in Palace Yard, which threw its beams over some part of the Embankment; but some worthy fossils among our legislators objected to this, and that, too, was withdrawn. At length a revulsion has begun to set in in favor of electricity, and it seems probable that that exceedingly "gassy" body, the London County Council, will cause the electric light to be reinstalled; though it is rumored that, in order to demonstrate that imbecility still has some say in the government of the great metropolis of the empire, the lights will be extinguished at midnight, probably as a concession to that strong and influential body of electors so worthily represented by the late lamented William Sykes. You can't expect everything at once, or even too much of it when it comes, in this country. There has been some "chortling" among the electrical folks over the expedition with which an English firm has contrived to furnish an electrical installation required for the famous Ruby Mines in Burma. The authorities wanted the plant to be ready in July, the manufacturers said that it could not possibly be done until November. Sir Lepel Griffin, the energetic Anglo-Indian official who is chairman of the Ruby Mines Company, can say unpleasant things rather more unpleasantly than most people, and he dropped some vitriotic hints about Atbara, whereupon it was discovered that the machinery could be sent out by July after all. It was a nasty knock you gave us over that Atbara business, but it has done our people a world of good, and has furnished a most serviceable watchword.

One of the peculiar features of electric lighting progress over here is that it is the poor neighborhoods that have the best and most profitable installations. In this connection considerable attention has lately been directed to Shoreditch, one of the poorest districts in London, where the electric light, supported by the dust destructor, has been a phenomenal success. A man can there light two rooms for eight pence or three rooms for ten pence a week, just half what he would be charged in the neighboring parish, and the profits, if shown as a dividend, would work out at more than 8 per cent, while the waste steam is utilized to heat the public baths, thus effecting a saving in the expenses of that institution of £1,800 in the year.

London, October 6.

Electric Illumination of Show-Windows.

With an increasing desire on the part of store-keepers to make the best appearance possible in the exhibits of their goods, there has arisen a curious branch of art known as window-dressing. In the principal cities, where the great department stores have large show-windows fronting on the prominent thoroughfares, men who have made a special study of the decoration of such windows are employed, and often earn large amounts of money by the skill which they display in their tasteful arrangement. It is only of late, however, that the powerful assistance of the incandescent light has been invoked in this form of decoration. The results attained by its use have been remarkably beautiful, as the illustration herewith well shows. The photograph from which this was made was taken at night by the light of the electric lamps in the window. The display is in the store of Meyer Jonasson & Company, in Boston. In the false ceiling of the window there are thirty-two sixteen candle-power lamps, each of which is surrounded by a shallow, sectional mirror reflector, giving a very soft and diffused light over the whole area of the window. The models, which are very much more artistic than those that were in vogue several years ago, stand around in lifelike attitudes and are, of course, most elaborately and sumptuously clothed to exhibit the manufactures of the firm. The reflectors used are of the shallow, flaring variety, built up of sectors of mirror glass. They were constructed by I. P. Frink, 551 Pearl street, New York, who has made a special study of window and other illumination of this character for many years. The beauty of the result obtained may best be judged by an inspection of the illustration, which shows a most attractive exhibit.



A Handsome Example of the Electric Illumination of Show-Windows.

Who Does Electric Welding?

To the Editor of Electrical Review:

Will you kindly let me know who does electric welding for light work in this city or near here.

W. W. Bostwick.

New York, October 31.

"Air Telegraphy."

To the Editor of Electrical Review:

In regard to the term of "wireless telegraphy" I would suggest the following names for your consideration: Electro air line, air telegraphy, Marconi's telegraphy.

G. P. Hachenberg.

Austin, Tex., October 19.

Foreign Readers of the "Electrical Review."

To the Editor of Electrical Review:

We take pleasure in acknowledging the value of the Electrical Review and its foreign circulation. We are very much obliged to you, indeed, for sending us this clipping, and hope that the "Farmers' Community System" will have as wide use in the telephone world as it seems to have acquired notoriety, thanks to the Electrical Review.

The North Electric Company,
By F. F. Sapp.

Cleveland, October 13.

Who Makes Profile Road Maps for Automobilists?

To the Editor of Electrical Review:

Do you know if such a thing is to be had as profile maps of the various roads radiating from New York, showing at a glance distances, gradients and length of same, together with descriptions of the roadbed? I have been looking for such maps, and I have so far been unable to find them, although they are in use in England, and are of great assistance, especially to cyclists and automobilists.

Of course, if any one takes the trouble, he can take the ordinary contour maps and make for himself a profile plan, but the average man does not care to go to this trouble, but would rather trust to chance as to what he will find.

Such books would be extremely useful to people desiring to go as far as possible on one charge. If you can get hold of such a thing for me I should be greatly obliged to you.

M. K. Eyre,

New York, November 2.

The Mechanism of the Wehnelt Interrupter.*

A painstaking investigation by Voller and Walter in *Wiedemann's Annalen*, Vol. 68, p. 526, goes a long way towards explaining the various processes, physical and electro-chemical, to which the remarkable action of the Wehnelt break is due. It certainly disposes, once for all, of certain favorite theories that have been advanced by some of our great authorities.

What led to the investigation was an observation by Walter that the flames about the anode, when the break was working, gave a very decided hydrogen spectrum. The occurrence of hydrogen at the anode would, of course, be impossible in normal electrolysis. In order to make certain whether hydrogen was present in any considerable quantity, the gases from the anode were collected in a tube and tested, when both hydrogen and oxygen were found to be present in proportions varying considerably according to circumstances.

We shall not describe in detail the apparatus used by Voller and Walter. It will be sufficient to say that the electrodes of the Wehnelt cell were so arranged, that the gases could easily be collected from either of them in explosion tubes. The primary coil of a 30-cm. Kohl induction coil was placed in circuit with the Wehnelt. This coil could be removed from its own secondary, and placed in the secondary of a 50-cm. Kohl. The discharge of sparks was found to be much stronger in the second case, showing, what has been already noted, that, to get the best results with a Wehnelt, the relative proportions of the primary and secondary must be very different from those that are best in the ordinary induction coil.

The gas collected from the anode of the Wehnelt, was always found to be an explosive mixture of oxygen and hydrogen. The relative quantities of the exploded and the residual gases varied considerably in different experiments. The proportions changed not only with the length of the anode wire and the strength of the applied current, but also with the magnitude of the inductance of the primary coil in circuit. The greatest difference was found between the results when the primary coil was lying free on the table, and when it was inserted in the largest secondary coil. For example, in the latter case, 45.5 ccm. of anode gas left, after explosion, a residue of 37.4 ccm., while in the former case, *ceteris paribus*, 51 ccm. of anode gas left a residue of 10 8 ccm.

On the assumption than the anode gas consisted entirely of a mixture of oxygen and hydrogen, and that after the explosion pure oxygen only was left, it is easy to calculate from the above figures that, in the first case, the anode gas contained 11.9 per cent of hydrogen, and in the second case 52.6 per cent. The above percentages can only be looked upon as approximate, since the residual gas, when tested, was found to contain 2 or 3 per cent of nitrogen derived from the gases dissolved in the electrolyte, and a considerable proportion of ozone was also found to be present. But the differences made by these corrections would not be great.

The anomalous presence of hydrogen in the anode gas of the Wehnelt cell might of course be due to the presence of oscillating currents. But if such were the case a corresponding

FIGS. 1, 2, 3 AND 4.—WEHNELT INTERRUPTER.

quantity of oxygen ought to be found in the cathode gas. To test this a quantity of the cathode gas was collected. It was found to be non-explosive, but as this might have been due to oxygen being less than one-seventh of the total volume, a more direct test was applied. A quantity of the cathode gas was shaken up in a tube with an alkaline solution of pyrogallic acid. A very small percentage of oxygen gas was found in this way, but this was shown to be derived, like the nitrogen, from the gas dissolved in the electrolyte, by making a duplicate test with the wire anode replaced by a platinum plate anode. In the latter case the same percentage of oxygen was found in the cathode gas. These experiments completely upset the theory of the existence of oscillating currents in the Wehnelt cell.

It became thus highly probable that the anomalous electrolysis in the Wehnelt interrupter occurred only at the anode, and further observations on the volumes of gas evolved at the respective electrodes appeared to establish this beyond doubt. Suitable apparatus was arranged to collect and measure the gases evolved, and to measure at the same time the mean current strength. As an example, the data obtained from one such experiment are here given. The 50-cm. coil, with its own primary, was used in the experiment. The quantity of anode gas obtained was 441 ccm., of cathode gas 387 ccm., the mean current was 9.4 amperes, and the duration of the experiment 6 minutes. The quantities calculated by Faraday's law ought to be, at the anode 196 ccm. of oxygen, at the cathode 393 ccm. of hydrogen. The volume of the cathode gas, within the limits of accuracy here attainable, agrees with the theoretical quantity, while the volume of the anode gas is 2¼ as much as it ought be in the normal electrolysis.

It was found, moreover, that this excess of the volume of the anode gas depended very much on circumstances. As extreme cases, the results of two experiments may be given, in one of which the 30-cm. primary was placed first outside (free, on the table), and, secondly, inside the 50-cm. secondary. In the first case, the volume of the anode gas was 3.7 times as much as the theoretical amount; in the second case, it was only 4 per cent greater. But this second quantity of anode gas was by no means pure oxygen, but contained enough hydrogen to render it explosive. It was found, moreover, that in the first experiment the anode gas, besides its large quantity of hydrogen, contained 38 per cent too much oxygen, and, in the second experiment, it contained 6.1 per cent too little.

A simple demonstration that the anomalous electrolysis takes place entirely at the anode was obtained by placing in circuit with a Wehnelt cell a normal cell, the same in every respect, except that the wire anode was replaced by a platinum plate anode. The following were the volumes of gas obtained:

	Normal cell	Wehnelt cell.	Theoretical (calculated).
Anode..	...226 ccm.	475 ccm.	229 ccm.
Cathode...	457 "	452 "	458 "

A comparison of these figures shows distinctly that the anomalous development of gas occurs at the anode of the Wehnelt only.

The authors tried some experiments to determine whether the anomalous electrolysis took place at the anode of the Wehnelt cell when the self-induction coil was removed from the circuit. This they found to be the case. There was not the same excessive volume of gas developed at the anode, but the anode gas was found to contain from 9 to 11 per cent of hydrogen. The experiments were made by placing a normal cell in the same circuit as the Wehnelt cell, as in the experiment described above. The best results were obtained by using a high E. M. F. (216 volts).

By reversing the current in the Wehnelt cell, it was found that brilliant spectra of the metals forming the wire electrode (now the cathode) could be obtained. The lines of sodium and hydrogen were also found on the spectrum, but that was considered an advantage, as they formed useful datum lines. The platinum wire was replaced by wires of other metals, which all gave brilliant and characteristic spectra.

Having established the existence of anomalous electrolysis at the anode of the Wehnelt cell, and completely demolished the theory of the existence of oscillatory currents, Voller and Walter proceeded to determine the time curve of the current between two successive breaks or interruptions of the current.

In passing, they point out that the existence of high E.M.Fs. in a circuit in shunt with the break is not peculiar to the Wehnelt break, but occurs equally in all breaks, as a consequence of the self-induction of the primary coil. As this experiment is chiefly relied upon by those who maintain the existence of oscillatory currents in the Wehnelt, they are brought face to face with the *reductio ad absurdum* that oscillatory currents must be produced by the ordinary break, even when a condenser is absent.

The rise of the current, after the circuit is made, follows exactly the same law in the Wehnelt as in the ordinary break. This is expressed by the well known formula—

$$i = \frac{E}{R}\left(1 - e^{-\frac{R}{L}t}\right)$$

where i is the current at any time t, E is the applied electro-motive force, R is the total resistance of the circuit, L its coefficient of self-induction, and e the base of natural logarithms. The curve representing the rise of the current is what is known as a logarithmic curve.

So far the action of the Wehnelt and the action of the ordinary mechanical break are identical. But one characteristic peculiar to the Wehnelt here comes in, namely, that the interruption in the Wehnelt cell always takes place when the make current has reached a certain value which is greater, the greater the surface of the anode wire is. This fact is best demonstrated by gradually reducing a resistance in circuit with an inoperative Wehnelt, till it just begins to work. It will be found that this always takes

* The (London) *Electrical Review*.

place with the same current strength, and that this critical current strength is proportional to the surface of the anode wire exposed to the electrolyte.

The following explanation for this peculiar phenomenon is put forward by the authors: The layer of fluid in contact with the platinum wire has the highest specific resistance of any part of the circuit. The Joule heat ($C^2 R$) generated there will, therefore, produce the quickest rise of temperature, and convert the layer of fluid into steam. This layer of steam is then electrolyzed or dissociated into a mixture of oxygen and hydrogen, which drives back the fluid electrolyte and breaks the circuit.

D'Arsonval has put forward the view that the envelope of steam around the platinum wire is generated by heat communicated from the wire to the surrounding liquid. But direct observation with the eye, and also with the spectroscope, proves that the platinum anode does not become white hot; the high temperature must, therefore, first arise in the liquid itself. Voller and Walter think that after the envelope of steam is formed, a discharge takes place across it of the same nature as the electric arc. But this point evidently requires further investigation.

Interesting results were obtained by the authors from an experimental investigation of the current time-gradient in a primary circuit containing a Wehnelt interrupter. The experiments were made by means of a Braun tube, in which the deflection of a fine stream of cathode rays is made use of to indicate the changes of the magnetic field and the primary current. The changes of the magnetism of the core were shown by placing the tube at right angles to the axis of the core. But since the magnetic field of the core is not a strictly accurate measure of the primary current, this was measured separately by another Braun tube placed at right angles to the axis of a solenoid in circuit with the primary coil.

By means of this apparatus, the time gradients of the primary current and of the magnetic field of the core were drawn. The results obtained are shown in Figs. 1, 2, 3 and 4. Fig. 1 shows two cycles of the primary current when there is no discharge between the terminals of the secondary coil, *i. e.*, the secondary coil has no more influence on the result than if it were not present. The steeper inclination of the curve, just before the current becomes constant, is probably due to the change of resistance caused by the formation of the envelope of steam round the platinum anode. What causes the current suddenly to become constant, and to remain so for about half of a complete cycle, is difficult to explain. Voller and Walter's view appears to be that electrolysis or dissociation of the steam is taking place. The final interruption of the current may be due, as in the electric arc, to over separation of the electrodes.

Fig. 3 shows the curve of the magnetism of the core, corresponding to the current curve Fig. 1.

Fig. 2 shows the time gradient of the primary current when a discharge is taking place between the terminals of the secondary. The rising gradient of the current is steeper on account of the reduction of the induction. The experiments described above showed that, in this case, a smaller volume of the mixed gases was given off. This appears to correspond to a shorter duration of the constant current.

Fig. 4 shows the variations of the magnetism of the core under the same conditions as in Fig. 2.

It is evident that the falling gradient of the magnetic field, Fig. 3, is steeper that in Fig. 4, and experiment showed that the break tension in the first case was 200 volts, while in the second it was only 150. The authors think the greater volume of mixed gases liberated at the anode in the former case has something to do with this.

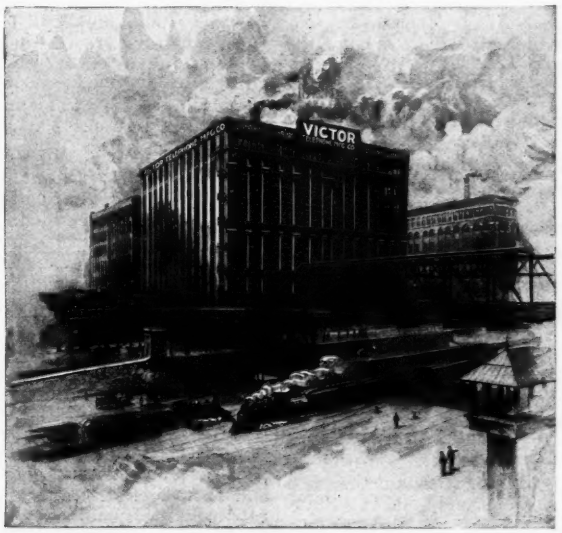
While the admirable investigation of Voller and Walter has thrown much light on the mechanism of the Wehnelt interrupter, much is still left to be explained.

The question of establishing an electric light plant at Milford, Utah, is under consideration.

The Victor Telephone Manufacturing Company's New Factory.

Although but a year and a half has elapsed since the Victor Telephone Manufacturing Company, of Chicago, entered the telephone field, yet in that time it has built up a very large business among the exchanges in the United States, besides enjoying a heavy export trade. The high efficiency and other good qualities of its products has placed the Victor company in the front rank, and resulted in installations in every state and territory.

Owing to the rapid advance of the business, the company found it necessary to secure larger quarters to properly handle its growing trade.



THE VICTOR TELEPHONE MANUFACTURING COMPANY'S NEW FACTORY IN CHICAGO.

The accompanying illustration shows the new factory. The building is one of the largest and most centrally located in the Chicago manufacturing district. The new quarters give the Victor company one of the finest equipped and best appointed independent telephone manufactories in the world. The very latest and most modern automatic machinery has been installed throughout. The experimental and testing department is equipped with the latest electrical appliances for experimenting and making accurate tests.

The personnel of the company embraces some of the most widely known telephone men in the independent field. Mr. William T. Blaine, the president of the company, has given much thought and study to the telephone industry, and the success of his company is largely due to his untiring efforts and able management. Mr. H. C. Dodge, who has affiliated himself with the Victor company, and is actively interested in its success, is a thorough telephone expert and engineer, and one of the most widely known telephone men in the independent field. Mr. William H. Chambers is the secretary and treasurer of the company, and Mr. H. B. McMeal has charge of the advertising department. The electrical engineering department is under the direction of Mr. E. E Yaxley, who is an electrical engineer of wide experience. Mr. Yaxley is assisted by Mr. C. C. Cadden, who has been for several years with the Western Electric Company in the switchboard department, having drawn the circuits for some of the largest boards installed by that company. Mr. A. J. Rousseau and Mr. James S. Healy are traveling representatives of the company.

BUSINESS NOTES.

De Veau & Company, 27 Rose street, New York city, have just closed a contract for a complete interior telephone system for the Victoria Hotel, New York city. The system will include 300 instruments, and will be of the most up-to-date character.

The Columbia Incandescent Lamp Company, of St. Louis, has just sent out a handsome blotter advertising the good points of the well known Columbia lamp. The blotter carries a picture of the cup defender Columbia, illuminated from a cloudy sky by a Columbia lamp, with the legend "The Two Winners." Columbia lamps are carried in stock at all the company's branch offices.

The Committee on Exhibits of the National Association of Municipal Electricians, which held its convention at Wilmington, Del., September 4–9, 1899, has submitted its report, which deals in a highly complimentary manner with the exhibits there shown, and especially refers to that of the Montauk Multiphase Cable Company, New York city. The committee speaks in the highest terms of the cable as being a valuable appurtenance for the protection of life and property. Manufacturers of insulated wires and electrical specialties were also commended for the handsome exhibits they made.

The North Electric Company, 261 to 273 Frankfort street, Cleveland, Ohio, has just issued some new printed matter which is of interest to all connected with telephone work. The printed matter takes the form of pamphlets describing various lines of the North Electric Company's specialties. An especially interesting one is that devoted to the "farmers' community system," with which the North Electric Company is having great success. Another pamphlet refers to telephone protectors and cutouts, and a third to small switchboards, including a description of the North company's repeating coil. Any or all of these pamphlets may be had free by writing to the company at the above address,

ADVANCE INFORMATION

New Telephone and Telegraph Companies.

JEWELL CITY, KAN.—A telephone company has recently been formed in Jewell City, with Mayor J. W. Berry, president; Albert Whitney, secretary, and Geo. B. Crandall, treasurer. The system, when complete, is to include Jewell City, Mankato and Burr Oak, and will probably be extended to Ionia, Mayview and Randall.

BRUCE, S. D.—A telephone system has been established at this place.

PITTSBURGH, PA.—Extensive improvements are under way for the enlargement of the telephone service in the Chartiers Valley. It is proposed to build a line from Washington to Pittsburgh, *via* Carnegie and Grafton, connecting all the towns in the Chartiers Valley. The small exchange at Canonsburg has been overhauled, and the one at Carnegie, where two switchboards are now in regular operation, is to be overhauled and remodeled. The Canonsburg line is to be extended to Houstonville, and thence to Washington. The Federal Telephone Company, capitalized at $10,000,000, is now in possession of all the independent lines in that vicinity, and is reaching out for business in all directions.

EDMESTON, N. Y.—The Morris Telephone Company will build a new line from this place to Morris, by way of Garrattsville, and down the Butternut Valley to Mt. Upton. The company already controls the Central New York Company's wire from Morris to Oneonta.

ST. EDWARD, NEB.—The Nebraska Telephone Company has completed its line into this city. St. Edward now has local connections, and is able to communicate with the outside world.

IOWA CITY, IOWA—The Johnson County Telephone Company has been incorporated; capital stock, $25,000. It will at once proceed to build an independent telephone line to Iowa City and Johnson County.

HAMILTON, OHIO—The Eaton Telephone Company has been incorporated, with a capital stock of $50,000. The directors are W. W. Morrison, of Bryan, Ohio; Fred J. Bollmeyer, of Wauseon, Ohio; C. F. Brooke, Jr., C. B. Cokefair and John Alexander, of Eaton.

WHARTON, TEX.—The Southwestern Telegraph and Telephone Company is now building a line between this place and Victoria, which will be completed as soon as possible.

PASS CHRISTIAN, MISS.—The American Telephone and Telegraph Company, to construct and operate telephone and telegraph lines, has been incorporated; capital, $25,000; incorporators, E. J. Hall, E. P. Meany, M. Ekleston, C. R. Bangs, A. W. Crandall, T. M. Miller.

FREEPORT, PA.—The Freeport Telegraph and Telephone Company has been incorporated; capital, $5,000; incorporators, B. Way, T. G. Cornell, J. T. McCulloch, J. E. Williams, C. A. Rogers, all of Freeport.

CLARKSVILLE, OHIO—The Clarksville Telephone and Telegraph Company has been incorporated; capital, $1,000; incorporator, Z. F. Garland.

HUMBOLDT, N. Y.—The Gibson County Telephone Company has been incorporated; capital, $20,000; incorporators, E. L. Mendenhall, E. B. Mendenhall, W. Mendenhall, V. T. Grizzard, J. T. McKibben, all of Humboldt.

CHATTANOOGA, TENN.—The long-distance telephone line between this place and Bristol has been completed. This completes the most important extension that the East Tennessee Telephone Company has been working on in this section of the state.

CANNON, MINN.—The Cannon Valley Telephone Company has been incorporated to operate a line between Cannon Falls and neighboring towns.

EATON, OHIO—The Eaton Telephone Company has been incorporated; capital, $50,000; incorporators, W. W. Morrison, F. J. Bollmeyer, C. F. Brooke, Jr., J. Alexander, C. B. Cokefois.

NACOGDOCHES, TEX.—The American Telegraph and Telephone Company, owned and controlled by E. C. Branch, Esq., and Captain I. L. Sturdevant, is now extending its lines from Lufkin to Corrigan, and will at once continue from the latter point, along the line of the Houston East & West Texas Railroad, to the city of Houston.

DOVER, DEL. — Among the new corporations chartered at the State House to-day was the Inter-State Telephone Construction Company, with a capital stock of $1,000,000.

New Electric Railways.

BEDFORD, N. Y.—The Bedford & Eastern Railway, an electric street surface railroad three miles in length to operate in the town of Bedford, has filed articles of incorporation with the Secretary of State; capitalization, $30,000; directors. Charles Haines, William H. Lyon, of Bedford Station; William V. Malloy, of New Rochelle, and George Jeungot, Jr., and Horace B. Thacker, of Croton Falls.

BIDDEFORD, ME.—Petitions have been filed for the incorporation of two companies to build electric roads to run into Biddeford. One is to be known as the York County Electric Railroad Company, and proposes to construct a line from Biddeford, through Goodwin's Mills and Waterboro and Limerick, to Hollandville, a woolen manufacturing village in Limerick. This line will be 25 miles in length. The route crosses the Portland & Rochester Railroad at Centre Waterboro; the capitalization is $250,000. The other road is to be known as the Biddeford, Kennebunk & Wells line, and is to connect these places; capital stock is $200,000. Theodore P. Dresser is the chief promoter of both these new companies. The other directors mentioned in the petitions are Eleazer B. Loring, Boston; C. S. Hamilton, Edgar A. Hubbard and William A. Roberts, Biddeford, and James O. Bradbury, of Saco.

FREETOWN, MASS.—Articles of association for the construction of an electric road from this place to Buzzard's Bay, to be known as the Boston & Cape Cod Railway, have just been secured through the Secretary of State. The signers of the articles include many prominent citizens of each town through which it is proposed to have the line pass. The proposed route is from the Freetown line, through Rochester, Wareham and Onset, to Buzzard's Bay. At Freetown it will form a connection with the Lake Shore road, which was recently built, and with a proposed road to Fall River. With these connections the new line will open up electric communications with New Bedford, Fall River, Taunton, Middleboro and Boston.

NEW FLORENCE, MO.—A plan to build an electric railway from this place to Middletown, a distance of 22 miles, has taken definite shape by the organization of a company at Belleflower. John W. Schowengerdt is its president; Howard Ellis, secretary. The road runs through the best section of Montgomery County.

CARLISLE, PA.—A trolley line will be constructed between this city and Churchtown.

MIDDLETOWN, N. Y.—The Middletown-Goshen Electric Railway Company has been incorporated to construct and operate electric railway; capital, $100,000; incorporators, W. B. Royce, H. B. Royce, of Middletown; W. F. Biddle, E. H. Pyle, all of Philadelphia, Pa.

MARION, IND.—The Marion Transit Railway Company has been incorporated; capital, $150,000; incorporators, E. H. Ferroe, J. A. Gauntt, A. S. Wade, P. Peslle, W. T. Caumack, H. Williamson, M. Petrie, all of Marion.

JEFFERSONVILLE, IND.—Capt. Ed Howard, proprietor of the shipyards and owner of the street railway line, has decided to put in an electric system, and soon will begin work making the change. The system will be extended so as to reach the Reformatory, which is not reached by the line at present, and also to Arctic Springs, a pleasure resort about two miles above the city.

BEDFORD STATION, N. Y. — The Bedford & Eastern Railway Company has been incorporated; capital, $30,000; incorporators, C. Haines, W. H. Lyon, of Bedford Station; W. V. Malloy, of New Rochelle; G. Jeungst, Jr., H. B. Thacken, C. J. Oecker, all of Croton Falls.

RICHMOND, IND.—It is announced on good authority that the electric line from Eaton, Ohio, to this city positively will be built next year. The line will be an extension of the Dayton & Western Traction Company, which has a line from Eaton to Dayton.

MILLBURY, MASS.—The Millbury, Sutton & Douglas Street Railroad Company has secured an extension of its charter until October 10, 1900, and has the necessary capital, $150,000, assured to build the line connecting the towns named. The distance is about 12 miles, and the road will be built next season if the rail can be secured.

New Incorporations

BROOKLYN, N. Y.—The Consolidated Electrical Supply Company has been incorporated; capital, $10,000; directors, F. F. Braillard, Jr., of 33 Bond street, and Grace B. Braillard, of Brooklyn.

PHILADELPHIA, PA.—The National United Manufacturing Company has been incorporated; capital, $1,000,000; incorporators, T. H. Springer, W. H. Rainsford, W. B. D. Smith, R. Thayer, J. S. Thorn, all of Philadelphia, Pa.

NEW YORK, N. Y.—The E. Lindner Manufacturing Company has been incorporated to manufacture electrical goods, etc.; capital, $10,000; incorporators, E. Lindner, of Brooklyn; M. B. Ault, of Unionport; O. Pullich, of New York city.

SEATTLE, WASH.—The Pacific Coast Fixture and Electric Company has been incorporated; capital, $25,000.

PASSAIC, N. J.—The Citizens' Gas and Electric Light Company has been organized to manufacture gas and electricity.

Electric Light and Power.

PARIS, TEX.—The City Council of Cooper, Delta County, is considering the proposition of putting in an electric light plant.

KANE, PA.— The Kane Electric Light and Power Company has been incorporated to supply light, heat and power; capital, $25,000; incorporators, D. H. Miller, C. V. Gillis, A. P. Hucy, A. Cleminger, C. E. Goodwin, E. H. McCleery, all of Kane.

DETROIT, MICH. — Capitalists in Calumet are organizing a stock company to erect an electric lighting plant at Lakeview, near Calumet, and purpose to furnish lights for business houses and residences in the latter place. They intend to run an underground system of wiring from the plant to the city.

BELLINGHAM, MASS.—The selectmen have granted a franchise to the Norfolk Electric Lighting Company for commercial lighting.

Increase of Capital.

HINCKLEY, ILL. — The Northern Illinois Telephone Company has increased its capital stock from $10,000 to $30,000.

Kindred.... ...Interests

The Electric Appliance Company, Chicago report a steady increase in sales on all classes of electrical supplies. Their increase on sales of Packard transformers, however, easily leads the list.

The Edison Decorative and Miniature Lamp Department of the General Electric Company, Harrison, N. J., has just issued a highly attractive catalogue of Roentgen-ray apparatus, including Crookes tubes, coils, screens, interrupters, etc.

The National Conduit Company, of St. Louis, Mo., has received from the United Railway Company, of St. Louis, a contract for 200,000 feet of cement-lined iron pipe. This is the first order from the railway company, and probably others will follow, as extensive work of this nature is proposed.

"Telephone Cables and Their Equipment and Installation" is the title of a handsomely prepared pamphlet issued by the John A. Roebling's Sons Company, of New York city. The pamphlet should be in the hands of every telephone man, as it contains information of interest and value to that branch of the fraternity.

The electrical equipment of the new jewelry factory of F. H. Richardson, Newark, is completed and will be put into regular service immediately. It consists of two American-Ball duplex compound engines and 50-kilowatt direct-connected generators, furnished by the American Engine Company, of Bound Brook. These machines will furnish power by electrical transmission to all floors of the new building.

Typographical Union Number 6 will hold a mammoth printing exposition at its semi-centennial in May, 1900, at the Grand Central Palace, New York city. It will embrace all the trades connected with the art preservative, and will be under the general management of Mr. Marcus Nathan, who is well known to electrical men. A very handsome prospectus of the exposition has been issued.

Continued rush of orders—The Bullock Electric Manufacturing Company, of Cincinnati, report 55 orders for the month of October, the machines ranging in size from the smallest to 300 kilowatts capacity. A repeat order was received from the Maryland Steel Company, of Sparrows Point, Md., this making the fifth order and being for a 300-kilowatt generator and several motors. Orders were received from the London, England, *Star*, and St. Petersburg, Russia, *Novoe Vremya*, two of the most important papers of the respective cities, for the Bullock "teaser" equipment for operating newspaper presses. Two 300-kilowatt alternating-current generators were shipped to the Willson Aluminum Company, of Holcombs Rock, W. Va., to be used in the manufacture of ferrochrome, an electro-chemical product used in the manufacture of chrome steel.

The New York Trade School, First avenue, between Sixty-seventh and Sixty-eighth streets, New York city, has just begun its annual season of semi-monthly lectures to journeymen electrical workers. The lectures will be conducted by Mr. A. A. Hammerschlag, their subjects being as follows: October 27—Volts, amperes and ohms. A simple demonstration and explanation of the units of pressure, quantity and resistance. November 10—How to calculate the size of wires for leads, feeders, mains, etc., for both light and power. November 24—How to lay out a feeder and main system. Actual problems. December 8—Testing for grounds, leakage and insulation resistance. Practical demonstration with apparatus. December 22—The dynamo or generator. Its construction, operation and output. Thorough explanation of all its parts. January 5—The electric motor. Its construction, operation, efficiency and maintenance. Wiring for same. January 19—Connecting motors and dynamos. Testing for polarity, leakage and grounds. February 2—Switchboards Laying out switchboards for isolated plant and for street circuit, singly and combined; busbars, switches and connections. February 16—Circuit-breakers, rheostats, volt and ammeters for switchboards. Purpose and design of each to be thoroughly explained. March 2—The three-wire system. Why used and where, with demonstrations. March 16—The storage battery. Its construction, operation and maintenance. March 23—Isolated plants, including dynamo, motors, lights, switchboards, wiring, etc. Many of the lectures given nowadays on electrical subjects are too deeply scientific for the practical workman. They are more fitted for the engineer. This course which is now offered will be the reverse, and each lecture has been arranged with a view of meeting the needs of the practical workman.

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Electrical.... Patents.

[Specially reported for this journal by E. S Duvall, solicitor of patents, Loan and Trust Building, Washington, D. C. Copies of any patent may be secured for 10 cents each.]

ISSUED OCTOBER 31, 1899.

635,739 Armature for dynamo-electric machines; S. Bergmann, New York—An armature disk, having stamped-up portions bent at right angles to the plane of the disk, some of said stamped-up portions being arranged at approximately uniform angles to the intersecting radii of the disk.

635,740 Electric arc lamp; S. Bergmann, New York, N. Y.

635,765 Electric signal; H. T. Gibbs, Portsmouth, R. I.—A signal system for electric railroads, consisting of a signal, a telephone-line and means located at a central station for shunting a trolley-current onto the telephone-line to set the signal.

635,774 Storage battery; A. Heinemann, Berlin, Germany.

635,786 Means for regulating constant-potential transformers; W. A. Layman, St. Louis, Mo.

635,812 Telephone transmitter arm; L. Schmidt, New York.

PORTRAITS OF ELECTRICIANS.

The Italian Journal *L'Elettricità* has just issued a souvenir album of 100 portraits of prominent living electricians. It will be sent to any American address for 60 cents (3 lire).

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